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Six new deep-water sternaspid species (Annelida, Sternaspidae) from the Pacific Ocean

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Abstract

Most sternaspid species have been described from shallow water, and *Caulleryaspis* Sendall & Salazar-Vallejo, 2013 includes one deep water species: *C. gudmundssoni* Sendall & Salazar-Vallejo, 2013 from Iceland. In *Sternaspis* Otto, 1821, the most speciose genus, most species were described from shallow water and only three thrive in deep water: *S. maior* Chamberlin, 1919 from the Gulf of California, *S. princeps* Selenka, 1885 from New Zealand, and *S. riestchi* Caullery, 1944 from Indonesia. The study of some deep sea sternaspids from the Pacific Ocean in the collections of six research institutions resulted in the discovery of six undescribed species, and for three of them there were abundant materials showing ventro-caudal shield development. *Caulleryaspis fauchaldi* **sp. n.** is described based on specimens from Oregon and California; it differs from the known species because it has a shield with rounded anterior margins and its peg chaetae form thin, small spines. *Caulleryaspis nuda* **sp. n.** was collected off Oregon; it is unique because its shield lacks a layer of sediment particles firmly attached, but has instead a thin layer of small particles loosely attached. Four other species are newly described in *Sternaspis*: *S. annenkovae* **sp. n.** was collected east off the northern Kurile Islands in about 4,000 m depth; it differs from other species by having a bicolored body, with the introvert darker than the abdomen, and its ventro-caudal shield plates are divergent resulting in a divided fan. The second species, *S. maureri* **sp. n.** was found off Peru in 1296–6489 m water depths and in the Southwestern Pacific in 795–3830 m; it resembles *S. williamsae* **sp. n.** but differs because its shield has better-developed ribs, the fan has a shallow or indistinct median notch

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and has lateral notches well-developed. The third species, *S. uschakovi* **sp. n.**, was found in the Okhotsk Sea in 592–1366 m, off California in 1585 m, Gulf of California in 1200–1274 m, and Western Mexico in 2548 m; it resembles *S. africana* Augener, 1918 and *S. andamanensis* Sendall & Salazar-Vallejo, 2013 in having shields with a denticulate posterior margin; the latter two species live in shallow water and they differ from each other and from the new species by a combination of shield and papillae features. The fourth species, *S. williamsae* **sp. n.**, was found off Oregon in 1000–2400 m, and off California in 878–1246 m; it resembles *S. annenkovae* because both species have shields with fans narrower than the anterior margin width, but differ in the relative development of shield features and in the relative size of prostomium and mouth; as stated above it also resembles *S. maureri* **sp. n.** but its shield has poorly-developed ribs, its median notch is distinct, and the lateral notches are poorly developed or indistinct. Keys to identify all species of *Caulleryaspis* and *Sternaspis* are also included.

Keywords

Polychaete, taxonomy, systematics, introvert color, shield fan, shield development

Introduction

In the polychaete family Sternaspidae Carus, 1863, most species have been described from shallow water, of less than 200 m depth (Sendall and Salazar-Vallejo 2013); however, one of the two known species of *Caulleryaspis* Sendall & Salazar-Vallejo, 2013 and only three species in *Sternaspis* Otto, 1821 were described from deeper water, of around 1000 m depth: *S. maior* Chamberlin, 1919, *S. princeps* Selenka, 1885, and *S. rietschi* Caullery, 1944. The former was described from the Gulf of California, Eastern Pacific Ocean, whereas the two other species were described from specimens collected in the Southwestern Pacific. Deep water sternaspids are delicate, fragile and difficult to study because they are often rare, but some abundant specimens have allowed us to study the development of the ventro-caudal shield.

The study of the Pacific Ocean sternaspid material lodged in six major research institutions resulted in the recognition of six species which are newly described: *C. fauchaldi* sp. n. from off Oregon and California, *C. nuda* sp. n. from off Oregon, *S. annenkovae* sp. n. from off the Northern Kurile Islands, *S. maureri* sp. n. from off Peru and from the Southwestern Pacific, *S. uschakovi* sp. n. from the Okhotsk Sea, California, Gulf of California and Western Mexico, and *S. williamsae* sp. n. from off Oregon and California.

Methods

Specimens were cleaned with a small brush; measurements were made with a millimeter ruler and the ventro-caudal shield was measured with a micro ruler with 0.1 mm marks. Ventro-caudal shield fascicles were counted by viewing the chaetal bases end on because most were broken. Collapsed specimens were re-swollen by injecting the same preserving fluid with a syringe. Illustrations were prepared by assembling series of photographs by using HeliconFocus. Character choice and terminology follows a

recent revision (Sendall and Salazar-Vallejo 2013; species differentiation is especially based upon shield differences. Station data of the R.V. Anton Bruun cruise 11 are after Menzies and Chin (1966), and Maurer and Williams (1988). Specimens belong to the following institutions:

CAS	California Academy of Sciences, San Francisco
LACM	Natural History Museum of Los Angeles County, Allan Hancock Polychaete Collection, Los Angeles
SIORAS	Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow.
UNAM	Colección de Referencia de Invertebrados Bentónicos, Unidad Académica Mazatlán, UNAM, Mazatlán
ZIRAS	Zoological Institute, Russian Academy of Sciences, Saint-Petersburg
ZMUC	Zoological Museum, University of Copenhagen

Systematics

Sternaspidae Carus, 1863

***Caulleryaspis* Sendall & Salazar-Vallejo, 2013**
http://species-id.net/wiki/Caulleryaspis

Type species. *Caulleryaspis gudmundssoni* Sendall & Salazar-Vallejo, by original designation.

Diagnosis (emended). Sternaspids with introvert hooks falcate, tapered. Preshield region with 7 segments. Ventro-caudal shield flexible, usually with abundant sediment particles firmly adhered, rarely sediment particles loosely adhered; without well-defined radial ribs and concentric lines. Branchial filaments arranged in discrete branchial plates.

***Caulleryaspis fauchaldi* sp. n.**
http://zoobank.org/C35D7377-3C94-49A6-B124-98873D0BB7A5
http://species-id.net/wiki/Caulleryaspis_fauchaldi
Figures 1, 2

Sternaspis fossor: Hartman 1963:59; Fauchald and Hancock 1981:35 (*partim, non* Stimpson 1853).

Type material. Northeastern Pacific, Oregon. Holotype (LACM 5360), and paratype (LACM 5361), Cascadia Abyssal Plain, west of Yaquina Bay, R.V. Acona, Sta. AD 33, NAD 21 (44°30.0'N, 125°34.0'W – 44°39.0'N, 125°33.2'W), 2800 m, clayey silt, 25 Jan. 1963 (paratype breaking into two parts, 8.5 mm long, 4 mm wide, introvert not exposed; left shield plate 2.3 mm long, 1.5 mm wide).

Additional material. Northeastern Pacific. Oregon. Four specimens (CAS 128953f), variably damaged, Sta. BMT 556 (48°7.7'N, 127°4.8'W), 2519 m, 10 Sep. 1971, A. Carey, coll. (9–10 mm long, 4.0–4.5 mm wide; left shield plate 2.2–2.3 mm long, 2.4–2.5 mm wide). One specimen (CAS 129027f), Sta. BMT 557 (48°9.0'N, 127°4.2'W), 2519 m, 10 Sep. 1971, A. Carey, coll. (9.5 mm long, 4 mm wide; left shield plate 2.5 mm long, 2.9 mm wide). **Southern California canyons.** One specimen (LACM 5362), 8.1 km off Pyramid Head, Lighthouse, San Clemente Island, R.V. Velero IV, Sta. 6839 (32°46'30"N, 118°15'43"W), 1387 m, coarse sand, 30 Jun. 1960 (3.2 mm long, 1.8 mm wide, abdomen 2.5 mm long; left shield plate 0.8 mm long, 0.8 mm wide). **BLM (Bureau of Land Management), Baseline Study, Southern California Bight**. One specimen (LACM 5333), dried-out, BLM 81304, R.V. Thomas G. Thompson, Sta. 813 (33°0.903'N, 119°2.188'W), 1753 m, olive brown silt, biological box core , rep. 04 BFI/ B4-1, 23 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5335), dried-out, BLM 81308, R.V. Thomas G. Thompson, Sta. 813 (33°0.933'N, 119°1.919'W), 1753 m, olive brown silty mud, biological box core, rep. 08 BFI/ B4-1, 23 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5337), dried-out, BLM 81352, , R.V. Thomas G. Thompson, Sta. 813 (33°1.05'N, 119°1.96'W), 1723 m, olive brown mud, biological box core, rep. 52 BFI/ B4-1, 31 Aug. 1977, K. Fauchald, G. Jones, coll.

Description. Holotype (LACM 5360) and paratype breaking into two pieces (Fig. 1A, D). Body grayish, with introvert exposed, slightly darker, broken dorsally; abdomen breaking ventrally, ventro-caudal shield grayish. Integument papillae abundant, shorter on introvert, larger on abdomen, incorporating sediment particles forming a thick coat over most of body (including introvert in paratype), arranged in single transverse series in posterior chaetigers. Body 9 mm long, 3 mm wide, about 28 segments.

Prostomium minute globose, ovoid, brownish (Fig. 1B). Peristomium small, oval, bearing abundant papillae resembling those present over introvert, extended as a wide band over prostomium. Mouth oval, small, slightly projected, covered by papillae.

First three chaetigers with about 16 falcate, tapered introvert hooks per bundle, each with subdistal dark areas (tips broken, darker areas look distal; subdistal in complete hooks). Genital papillae not seen (paratype with ventrolateral pores between segments 7 and 8). Pre-shield region with 7 segments (difficult to count because of specimens fragility); capillary chaetae along first pre-shield segment (paratype with capillaries in two segments).

Ventro-caudal shield completely covered by a thick coating of adhered particles (Fig. 1C), perforated, better preserved in paratype (Fig. 1E); suture not visible. Anterior margins clearly rounded; anterior depression deep; anterior keels not exposed. Ribs or concentric lines not visible. Lateral margins rounded, expanded medially, reduced posteriorly. Fan truncate, barely reaching posterior corners. Other features not visible.

Marginal chaetal fascicles include 9 lateral and only 4–5 short, small posterior ones (others probably broken), each with 3–4 chaetae per bundle. Peg chaetae robust, forming thin, short spines, close to posterior margins. Additional chaetal fascicles not visible.

Branchiae lost. Interbranchial filaments lost. Branchial plates slightly divergent, anteriorly expanded, rounded (Fig. 1F).

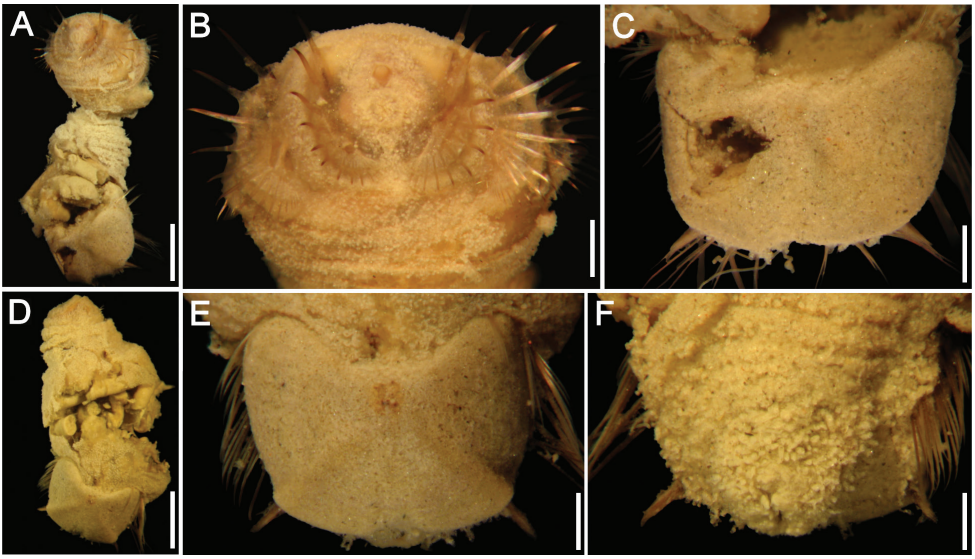

Figure 1. *Caulleryaspis fauchaldi* sp. n. **A** Holotype (LACM 5360), ventral view **B** Anterior end, frontal view **C** Ventro-caudal shield, frontal view **D** Paratype (LACM 5361), ventral view **E** Ventro-caudal shield, frontal view **F** Posterior end, dorsal view. Bars: **A** 1.8 mm **B, C, E, F** 0.6 mm **D** 2 mm.

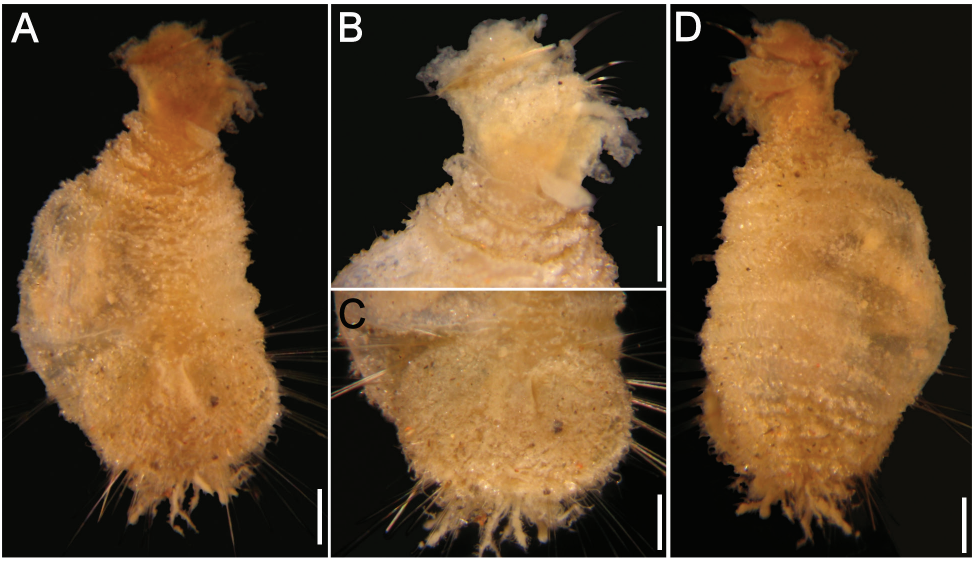

Figure 2. *Caulleryaspis fauchaldi* sp. n., juvenile specimen (LACM 5362) **A** Ventral view **B** Anterior end, ventral view **C** Ventro-caudal shield, frontal view **D** Dorsal view. Bars: **A, C, D** 0.38 mm **B** 0.26 mm.

Juveniles. Juvenile (Fig. 2A) with papillae less abundant and larger than those present in type specimens, homogeneously distributed throughout integument, eroded in introvert and arranged in transverse series as remains of erosion along dorsal surface

(Fig. 2D). Body about one-third as large as type specimens, with introvert damaged by compression (Fig. 2B). Ventro-caudal shield with sediment particles and abundant papillae (Fig. 2C); anterior margins poorly defined, lateral margins rounded, medially expanded. About 9 lateral chaetal bundles and 5–6 posterior ones with longer, thinner and fewer chaetae than in larger specimens. Peg chaetae not visible.

Etymology. This species is named after Dr. Kristian Fauchald, long-time teacher and friend, in recognition of his many contributions to polychaete systematics and especially because of his contribution to the study of deep-sea fauna including the off Oregon species. The epithet is a noun in the genitive case.

Type locality. W off Yaquina Bay, 2800 m depth.

Remarks. *Caulleryaspis fauchaldi* sp. n. is very similar to *C. gudmundssoni* Sendall & Salazar-Vallejo, 2013 because both have shields with a deep anterior depression and robust peg chaetae. These two species differ, however, in two main features. In *C. fauchaldi* the anterior shield margins are rounded, the introvert has longer papillae, and the peg chaetae form thin short spines, whereas in *C. gudmundssoni* the anterior shield margins are more angular, the introvert has shorter papillae, and the peg chaetae form thick, long spines.

Distribution. From Oregon to Southern California, in 1387–2800 m depth.

***Caulleryaspis nuda* sp. n.**
http://zoobank.org/B3C65AD6-0C77-421C-8CFB-8E9C724866D0
http://species-id.net/wiki/Caulleryaspis_nuda
Figure 3

Type material. Northeastern Pacific, Oregon. Holotype (CAS 129027h) and nine paratypes (CAS 129027p), variably damaged, Sta. BMT 557 (48°9.0'N, 127°4.2'W), 2519 m, 10 Sep. 1971, A. Carey, coll. (complete paratypes 9–11 mm long, 3–5 mm wide; left shield plate 1.8–2.1 mm long, 1.9–2.4 mm wide; oocytes 200 μm in smaller paratype).

Additional material. Northeastern Pacific, Oregon. Thirty-three specimens (CAS 128953), Sta. BMT 556 (48°7.7'N, 127°4.8'W), 2519 m, 10 Sep. 1971, A. Carey, coll. (complete 8.0–11.5 mm long, 3.5–5.5 mm wide; left shield plate 1.5–2.5 mm long, 1.5–2.4 mm wide; oocytes 200 μm).

Description. Holotype (CAS 129027h) with integument almost completely removed, some fragments remain in mid-body; body wall broken midventrally and dorsally (Fig. 3A). Integment and ventro-caudal shield pale brown, body wall whitish, introvert darker than abdomen. Body papillae mostly removed along with integument; papillae probably homogeneously distributed throughout body. Body 13 mm long, 5 mm wide, about 28 segments; left ventro-caudal shield 2.0 mm long, 2.2 mm wide.

Prostomium minute globose, ovoid, paler than peristomium. Peristomium small, oval, papillae lost. Mouth oval, small slightly wider than prostomium, barely projected, covered by papillae (Fig. 3B).

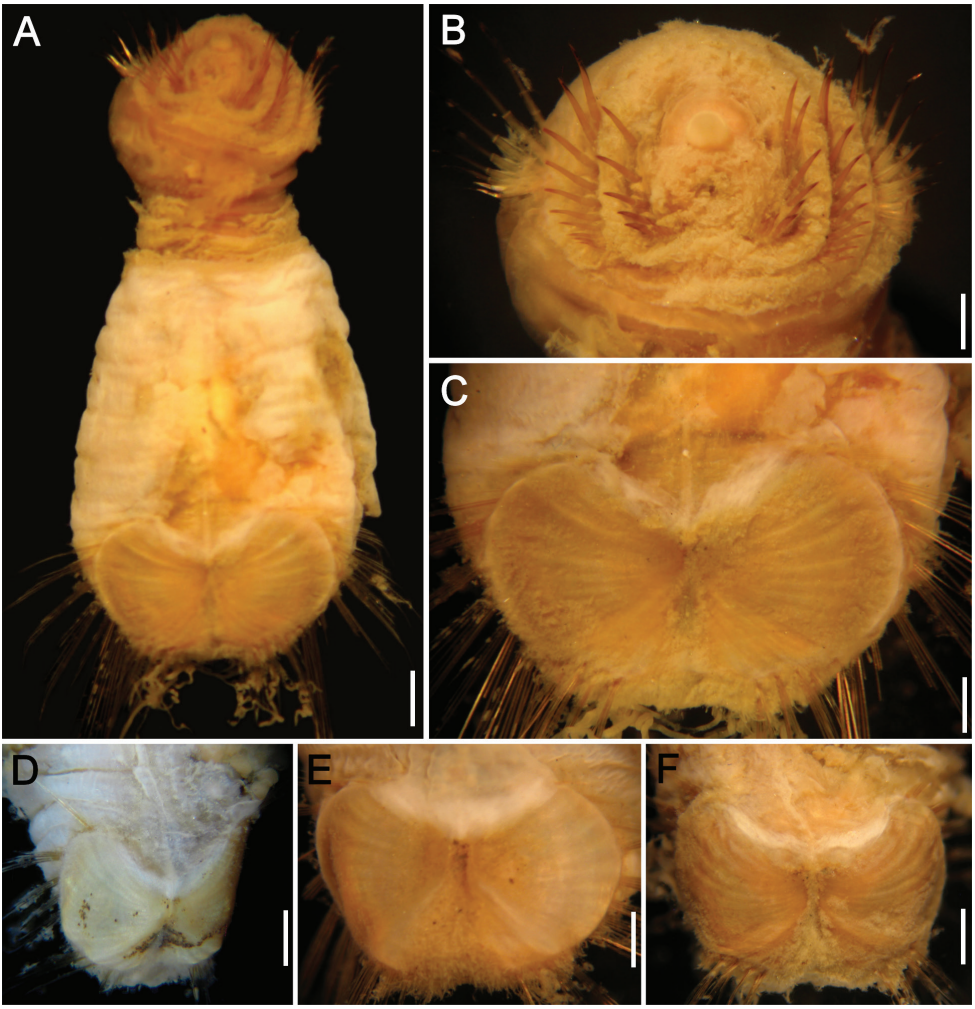

Figure 3. *Caulleryaspis nuda* sp. n., **A** Holotype (CAS 129027h), ventral view **B** Same, anterior end, frontal view **C** Same, ventro-caudal shield, frontal view **D–F** Paratypes (CAS 129027p), ventro-caudal shields. Bars **A** 1.2 mm **B, E** 0.6 mm **C** 0.5 mm **D** 0.8 mm **F** 0.9 mm.

First three chaetigers with about 16 falcate, tapered introvert hooks per bundle, each with subdistal dark areas, slightly paler distally. Genital papillae not seen. Pre-shield region with 7 segments; capillary chaetae not seen (some paratypes with capillaries in 2–4 segments).

Ventro-caudal shield completely covered by a thin, delicate coating of adhered fine sediment particles, mostly removed from shield; suture not visible (Fig. 3C). Anterior margins rounded; anterior depression deep; anterior keels not exposed. Ribs barely defined, concentric lines not visible. Lateral margins rounded, expanded medially, reduced posteriorly. Fan with a deep wide median notch, projected beyond the margins of posterior corners.

Marginal chaetal fascicles include 10 lateral and only 4 short, small posterior ones (others probably broken; some paratypes with up to six posterior bundles); lateral bundles with 7–8 chaetae each, posterior bundles with 5–6. Peg chaetae not visible (one paratype with minute, barely visible peg chaetae). Additional chaetal fascicles not visible.

Branchiae lost. Interbranchial filaments lost. Branchial plates convergent, anteriorly expanded, rounded. Some paratypes with broken body wall include oocytes, each about 200 μm.

Variation. All paratypes have shields without sediment particles firmly adhered or concentric lines (Fig. 3D–F). The anterior depression is deep, the anterior margins are projected, and the radial ribs are progressively better developed as growth proceeds. The posterior, median notch is well developed in all stages.

Etymology. The specific name is derived from the Latin adjective *nudus (a, um)*: naked, to indicate that unlike other species in the genus, its shield does not have firmly adhered sediment particles on it. The epithet is in the genitive case.

Remarks. *Caulleryaspis nuda* sp. n. is unique because its ventro-caudal shield is soft as typical for the genus, but instead of having a thick sediment particles cover, it has a very thin layer made by loosely adhered, fine sediment particles, which can be easily eroded or brushed off. However, the general shield outline of *C. nuda* resembles the one present in *S. williamsae* sp. n. (see below), and the latter can even incorporate some sediment particles, but they differ because in *C. nuda*, the shield does not have a thin, stiff, yellowish layer but rather a convex, delicate, pliable margin.

Distribution. Only known from off Oregon, U.S.A., in 2519 m depth.

Key to species of *Caulleryaspis* Sendall & Salazar-Vallejo, 2013

1 Shield with sediment particles firmly adhered; shield surface not visible..... **2**

– Shield without firmly adhered sediment particles; shield surface visible..... ..... ***C. nuda* sp. n. (Northeastern Pacific, off Oregon)**

2(1) Shield with anterior depression deep; peg chaetae robust **3**

– Shield with anterior depression shallow; peg chaetae indistinct .... ***C. laevis* (Caullery, 1944) (Indonesia)**

3(2) Shield with anterior margins angular; peg chaetae forming thick, large spines ... ...***C. gudmundssoni* Sendall & Salazar-Vallejo, 2013 (North Atlantic, Iceland)**

– Shield with anterior margins rounded; peg chaetae forming thin, small spines ... ***C. fauchaldi* sp. n. (Northeastern Pacific, Oregon to California)**

Sternaspis Otto, 1821

http://species-id.net/wiki/Sternaspis

Type species. *Sternaspis thalassemoides* Otto, 1821, by monotypy.

Diagnosis. Sternaspids with introvert hooks falcate, tapered. Pre-shield region with 7 segments. Ventro-caudal shield stiff, usually with abundant sediment particles loosely adhered; with well-developed radial ribs and concentric lines. Branchial filaments arranged in discrete branchial plates.

***Sternaspis annenkovae* sp. n.**
http://zoobank.org/4A4E8760-CD4A-472F-9765-D8B1F07AD0DB
http://species-id.net/wiki/Sternaspis_annenkovae
Figure 4

Sternaspis scutata: Levenstein 1961:167, 1966:59 (*non* Ranzani 1817, *partim*)

Type material. Northwestern Pacific Ocean. Holotype (ZIRAS 50602) and 11 paratypes (ZIRAS 50603), variably damaged, most with broken body wall and some broken by half, R.V. Vityaz, Sta. 2209 (49°46'01"N, 157°48'06"E), 3980–4070 m, grab Ocean, 1953 (five paratypes with introvert variably exposed and damaged, 6.0–11.0 mm long, 4.0–6.0 mm wide, ventral shield left plate 2.0–2.8 mm long, 2.1–3.0 mm wide; oocytes yellowish, still in ovary, about 200 μm; paratypes without introvert but abdomen well preserved, 6–12 mm long, 4.0–8.0 mm wide, ventral shield left plate 2.0–2.8 mm long, 2.3–3.5 mm wide; oocytes in ovary about 200 μm).

Description. Holotype (ZIRAS 50602) with body bi-colored; introvert not fully exposed, pale brown, abdomen whitish (Fig. 4A), ventro-caudal shield pale brick red (Fig. 4B, D). Introvert finely papillose, abdomen papillae mostly eroded, some retained in folds or around branchial region. Body 10 mm long, 7 mm wide, abdomen 8 mm long, left ventro-caudal shield plate 2.0 mm long, 2.7 mm wide.

Prostomium hemispherical (Fig. 4C), (similar in paratypes; slightly acute in one paratype), projected, slightly larger than mouth, with same pigmentation as introvert. Eyespots not seen. Peristomium rounded with abundant papillae, extended laterally over prostomium and ventrally to margin of first chaetiger.

Introvert chaetigers with 10–11 golden barely falcate hooks, each with subdistal dark areas but tips mostly eroded (Fig. 4C). Genital papillae small, digitate, with same pigmentation than introvert, barely visible in intersegmental groove between segments 7 and 8.

Anterior abdomen with 7 segments, papillae mostly eroded, some remaining in body depressions or around branchial region, but not arranged in series or groups. Capillaries not seen (two paratypes with capillaries in first two segments, two per bundle).

Ventro-caudal shield with lateral plates divergent, surface with ribs and concentric lines, the latter less pronounced, barely banded; suture visible throughout shield. Anterior margins rounded, midventral depression shallow (Fig. 4C). Lateral margins gently

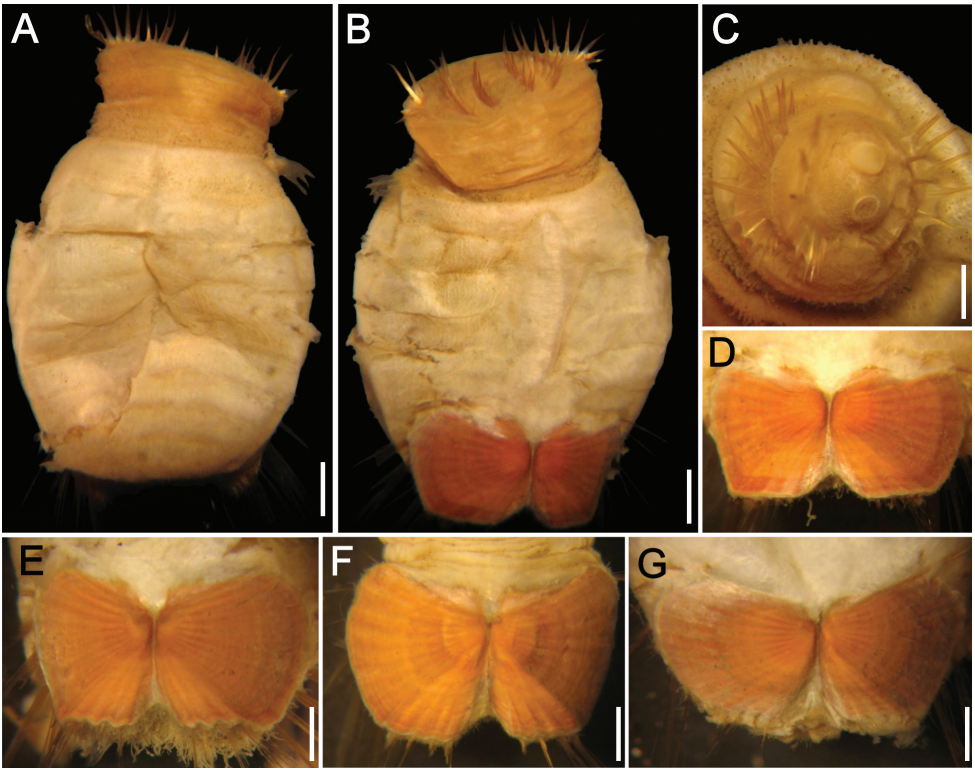

Figure 4. *Sternaspis annenkovae* sp. n. **A** Holotype (ZIRAS 50602**)**, dorsal view **B** Same, ventral view **C** Same, ventro-caudal shield **D** Paratype, anterior end, oblique frontal view **E**–**G** Ventro-caudal shields of three paratypes. Bars: **A, B** 1.3 mm, **C, G** 1.1 mm, **D** 0.7 mm, **E** 0.8 mm, **F** 1 mm.

rounded, not expanded posteriorly. Fan markedly notched, barely projected beyond poorly developed posterior corners, margin barely crenulated.

Marginal chaetal fascicles mostly broken off (Fig. 4B, C), 10 lateral ones with chaetae along an oblique series, and 7 posterior fascicles with chaetae in linear arrangement. Peg chaetae not visible.

Branchiae mostly lost (few remaining in paratypes, spirally bent); interbranchial papillae long, straight, often with fine sediment particles. Branchial plates observed in some paratypes, narrow, anteriorly rounded, wider than rest of branchial plate, with 8–9 filaments per series.

Etymology. This species name is after the late Dr. Nadezhda P. Annenkova, in recognition of her many publications on polychaetes, and for her efforts to build a strong taxonomic tradition in the early to mid XX century in Russia. The epithet is a noun in the genitive case.

Variation. The introvert is always pale brown, darker than the abdomen. Introvert chaetigers have 11–13 hooks per bundle. The ventro-caudal shield is pale

brick red or dirty orange, ribs and concentric lines are always visible but variably developed; anterior margins are rounded to barely acute (Fig. 4E–G); fan markedly notched, margin barely crenulated to markedly crenulated, barely projected beyond the posterior corners. The inner margins of each lateral shield plate are fused along ½ to 1/3 of its length, resulting in a divergent or markedly notched fan. The shield chaetal bundles are difficult to count in holotype; paratypes with 9 lateral, and 6–7 posterior bundles.

Remarks. *Sternaspis annenkovae* sp. n. is unique among the species in the genus and two features separate it. First, the body is bi-colored having a darker introvert and a pale abdomen, whereas in all other species the introvert is usually of the same color than the abdomen, slightly paler or even transparent. It is true that sometimes the sediment-filled gut can be displaced towards the introvert, making it look darker than the posterior region, but this can be noticed by transparency of the introvert's body wall, whereas in *S. annenkovae* the pigmentation is widespread and homogeneous in the introvert. Second, the lateral shield plates are divergent and separated throughout its posterior region such that the fan is markedly notched. Some *Sternapsis* species can have a more eroded shield in older specimens, whereas the younger specimens are less eroded; however, in *S. annenkovae* the markedly notched fan is evident even in small specimens, rendering it a consistent feature, not significantly modified during growth. The other three deep-water species (*S. maior, S. princeps*, and *S. rietschi*) do not have a median notch or, if present, as in *S. maior*, it is rather shallow. Further, there are two species that have shields with deeply notched fans, especially in larger specimens as shown elsewhere (Sendall and Salazar-Vallejo 2013): *S. costata* von Marenzeller, 1879 and *S. islandica* Malmgren, 1867. These species differ by having a wider fan such that the larger ribs form an angle of 100–120° whereas in *S. annenkovae* the fan is narrower and the larger ribs form an angle of 85–90°. However, as indicated in the key below *S. annenkovae* resembles *S. fossor* Stimpson, 1853 because their shields have radial ribs and concentric lines, fans with a deep, median notch, and poorly defined posterior corners. They differ because in *S. annenkovae* the introvert is darker than the rest of the body and its shield is wider anteriorly, whereas in *S. fossor* the introvert is paler or with similar pigmentation than the rest of the body, and the shield is wider medially.

On the other hand, *S. annenkovae* resembles *S. williamsae* sp. n. (described below) because in the ventro-caudal shields of both species the fan is narrower than the corresponding anterior margins. They differ because in *S. annenkovae* concentric lines are better developed, the fan is medially discontinuous, and the prostomium is larger than the mouth, whereas in *S. williamsae* the concentric lines are poorly developed, the fan is medially continuous, and the prostomium is smaller than the mouth.

Distribution. Only known from the type locality in the Northwestern Pacific Ocean, east off northern Kurile Islands, in 3980–4070 m depth. Levenstein (1961, 1966) deep water records from the Bering Sea could belong to this species but her materials were not found.

***Sternaspis maureri* sp. n.**
http://zoobank.org/22EEC1F6-2325-4E44-A66E-943CD62E0D88
http://species-id.net/wiki/Sternaspis_maureri
Figures 5, 6

Sternaspis fossor: Maurer and Williams 1988:694 (*non* Stimpson 1853).
Sternaspis scutata: Kirkegaard 1996:71–72 (*non* Ranzani 1817).

Type material. Eastern Pacific, Peru. Holotype (LACM 5679), and two paratypes (LACM 5680), R.V. Anton Bruun, Cruise 11, Sta. 100 (08°16S, 81°05W), Menzies trawl, 6156–6489 m, 16 Oct. 1965 (paratypes anterior or posterior fragments; ventro-caudal shield with fan slightly narrower than anterior margins; margin crenulated, median and lateral notches well developed). Six paratypes (LACM 5681), R.V. Anton Bruun, Cruise 11, Sta. 72 (08°25S, 81°05W), Menzies trawl and Beam trawl, 6220–6052 m, 12 Oct. 1965 (one complete, one broken into two pieces, two fragmented introverts. Complete 8.0 mm long, 2.3 mm wide, left shield plate 2.5 mm long, 2.2 mm wide. Shield with margin narrower than anterior margins, margin smooth, paler, median notch shallow, lateral notches well developed; other remaining shield plates 2.0–2.5 mm long, 2.2–2.5 mm wide). Three paratypes (LACM 5682), R.V. Anton Bruun, Cruise 11, Sta. 77 (08°22S, 81°02W), Menzies trawl and Beam trawl, 6052–6260 m, 13 Oct. 1965 (two broken in several pieces; one complete with most shield chaetal bundles broken. Complete with introvert partly evaginated, 7.0 mm long, 2.5 mm wide; left shield plate 2.4 mm long, 2.1 mm wide. Other specimens with left shield plate 2.0–2.5 mm long, 2.3–2.5 mm wide. Fan projected, smooth in smaller specimens, crenulated in larger ones. Median notch visible, smaller than lateral notches; better developed posterolateral corners).

Additional material. Eastern Pacific. One specimen (LACM 5684), R.V. Anton Bruun, Cruise 11, Sta. 36 (05°43'S, 82°01'W), Menzies trawl, 5047 m, 5 Oct. 1965 (broken into two portions, body wall broken, shield broken, one plate lost, the other missing a lateral part). Eight specimens (LACM 5686), R.V. Anton Bruun, Cruise 11, Sta. 69 (06°19'S, 81°49'W), Beam trawl, 5750 m, 11 Oct. 1965. (label with question mark about stations 55 or 69; herein regarded as part of station 69; two anterior fragments, one posterior fragment, two detached shields, three detached shield plates). 10 specimens (LACM 5683), R.V. Anton Bruun, Cruise 11, Sta. 94 (08°21'S, 81°25'W), Menzies trawl, 1296–1317 m, 14 Oct. 1965 (one broken into two pieces; six with introvert invaginated, three with introvert evaginated; complete specimens 1.8–4.8 mm long, 1.3–2.9 mm wide; left shield plate 0.4–1.0 mm long, 0.5–1.0 mm wide. Other specimens 2.0–4.2 mm long, 1.5–2.8 mm wide; left shield plate 0.5–1.0 mm long, 0.5–0.9 mm wide. Ventro-caudal shield fan starts being smooth or with a poorly defined posterior margin into a crenulated margin in larger specimens. All have the fan narrower than the anterior margin; median notch not developed, lateral notches well developed). One specimen (LACM 5685), R.V. Anton Bruun, Cruise 11, Sta. 98 (08°24'S, 81°15'W), Menzies trawl, 6052–5989 m, 15 Oct. 1965 (body wall broken,

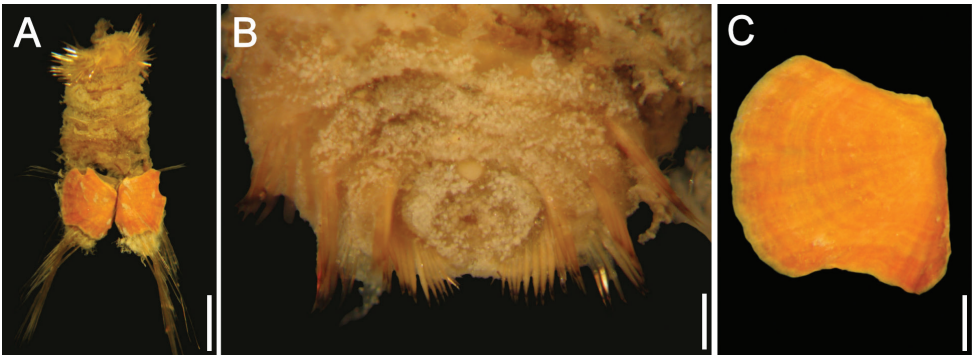

Figure 5. *Sternaspis maureri* sp. n., **A** Holotype (LACM 5679), ventral view, shield variably broken **B** Paratype (LACM 5680), anterior end, seen from above **C** Ventro-caudal shield, detached right part. Bars **A** 1.9 mm **B** 0.4 mm **C** 0.5 mm.

gut broken in pieces. Ventro-caudal shield with fan narrower than anterior margins, fan margin smooth, projected beyond the poorly defined posterolateral corners. Left shield plate 2.5 mm long, 2.3 mm wide). Two specimens (LACM 5689), R.V. Anton Bruun, Cruise 11, Sta. 98? (08°24'S, 81°15'W), Campbell grab, 6052 m, 15 Oct. 1965 (label with "Sta. 86 or 98?" but Maurer & Williams did not include station 86; both specimens broken, without introvert, shields detached from the body or still fixed over abdomen. Detached shield left plate 3.2 mm long, 2.6 mm wide. Shield with fan narrower than anterior margins, projected, margin crenulated, lateral notches well defined). One specimen (LACM 5690), R.V. Anton Bruun, Cruise 11, Sta. 101 (08°13'S, 81°09'W), Menzies trawl, 1927–1997 m, 16 Oct. 1965 (ventro-caudal shield with fan narrower than anterior margins, fan margin smooth, projected beyond the poorly defined posterolateral corners; left shield plate 1.2 mm long, 1.2 mm wide). Two specimens (LACM 5688), R.V. Anton Bruun, Cruise 11, Sta. 113 (08°44'S, 80°45'W), Menzies trawl and Beam trawl, 5986–6134 m, 19 Oct. 1965 (larger specimen without introvert; the other very small apparently with introvert invaginated. Larger specimen with ventro-caudal shield with fan narrower than anterior margins, fan margin smooth, projected beyond the poorly defined posterolateral corners; left shield plate 2.2 mm long, 2.2 mm wide. Smaller specimen with shield with fan projected beyond the poorly defined posterolateral corners; margin covered by sediment particles). One specimen (LACM 5691), R.V. Anton Bruun, Cruise 11, Sta. 196 (09°01'S, 80°40'W), Menzies trawl, 4516–4383 m, 7 Nov. 1965 (body broken into two pieces, most of body in one, the shield in another. Ventro-caudal shield with fan narrower than anterior margins, fan margin barely crenulated, projected beyond the poorly defined posterolateral corners. Left shield plate 1.3 mm long, 1.2 mm wide). **Southwestern Pacific**. One specimen (ZMUC 0000), juvenile, R.V. Galathea, S off Adelaide, Sta. 556 (37°18'S, 138°43'E), 795 m, 6 Dec. 1951 (7 mm long, 3 mm wide, left shield plate 1.2 mm long, 1.0 mm wide). One specimen (ZMUC 0000), R.V. Galathea, S off New Zealand, Sta. 607 (44°18'S, 166°46'E), 3830 m, 17 Jan. 1952

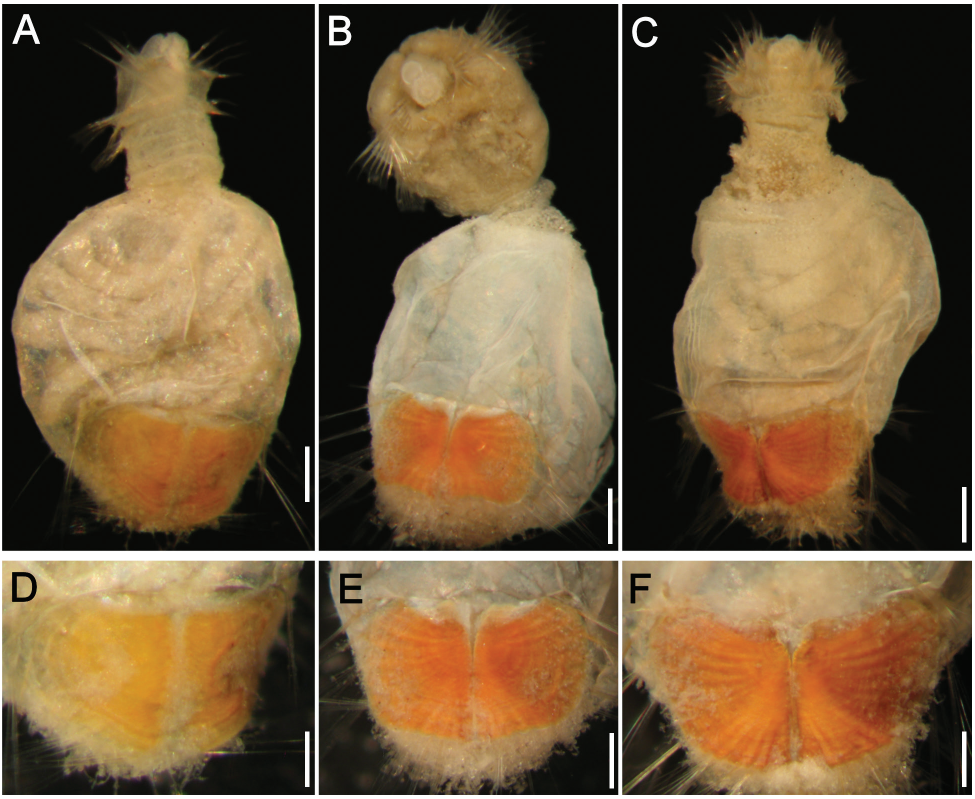

Figure 6. *Sternaspis maureri* sp. n., non-type specimens (Sta. 94 LACM 0000) **A**–**C** Ventral view of complete specimens **D**–**F** Ventro-caudal shields of the corresponding specimens. Bars **A** 0.2 mm **B** 2.2 mm **C** 0.6 mm **D** 0.15 mm **E** 0.3 mm **F** 0.4 mm.

(broken in two parts, partly dehydrated, and the shield is very fragmented, but most pieces remain on site; damage made by removing the sediment and papillae surrounding the anal peduncle lobe; right shield plate 1.8 mm long, 1.3 mm wide).

Description. Holotype (LACM 0000) complete. Body wall broken and inner organs lost (Fig. 5A). Body brownish, integument papillose throughout body, dark brown (eroded leaving a paler body wall in smaller paratypes; larger ones with darker body wall). Body 7 mm long, 3 mm wide, about 29 segments; left shield plate 2.5 mm long, 2.1 mm wide.

Prostomium eroded, small, ovoid, paler than surrounding areas, smaller than mouth (Fig. 5B). Peristomium rounded, abundantly papillose (especially in some paratypes), papillae extended throughout introvert. Mouth rounded, papillose, slightly projected.

First three chaetigers with 12–14 bronze, slightly falcate hooks per bundle, each with subdistal dark areas (up to 16–18 in some paratypes). Genital papillae lost (pale, blunt, short lobes in some paratypes, from the intersegmental groove between segments 7 and 8).

Pre-shield region with 7 segments, with papillae mostly eroded from segmental ridges, but present in intersegmental furrows or along some areas, homogeneously distributed. Short, about 4–5 capillary chaetae in some segments.

Ventro-caudal shield dark orange, with ribs partly eroded, concentric lines poorly developed; suture distinct throughout shield (Fig. 5A, C). Anterior margins rounded (broken in Fig. 5A), anterior depression shallow; anterior keels not exposed, barely developed. Lateral margins rounded, reduced posteriorly. Fan truncate, one-half to two-thirds as wide as anterior margins width, slightly projected beyond posterior posterior shield corners, median notch shallow, barely developed, lateral notches deeper, better developed, fan margin smooth to barely crenulated (paler in some paratypes).

Marginal chaetae fascicles damaged; eight or nine lateral ones (10 in one paratype Sta. 72), chaetae ovally arranged, and six posterior ones (paratypes more damaged). Peg chaetae visible, not broken, but detached, and a single long, delicate chaetae.

Branchial plate missing (one paratype (Sta. 72) with one plate left but no branchial or interbranchial filaments left; branchial plate ovoid, tapering anteriorly; another paratype from the same station with branchial plates anteriorly converging).

Variation. There are several ontogenetic changes in the ventro-caudal shield, although the anterior depression remains shallow throughout their development (Fig. 6). Smaller specimens (Fig. 6A, D) have yellowish or pale orange shield, with ribs barely visible. Medium-sized specimens have shields slightly darker, with ribs better defined but the main, diagonal rib is still poorly developed (Fig. 6B, E). In larger specimens, the shield becomes thicker, stronger and its ribs, including the diagonal one are better defined (Fig. 6C, F) and the lateral notches, over its posterior margin or fan, become deeper.

Etymology. The species name is after Dr Don Maurer in recognition of his many publications, mostly on benthic ecological studies and especially dealing with polychaetes. He also studied the material employed for this description. The epithet is a noun in the genitive case.

Type locality. W off Trujillo, Perú, 6156–6489 m depth.

Remarks. *Sternaspis maureri* sp. n. resembles *S. annenkovae* sp. n. and *S. williamsae* because they all have ventro-caudal shield fans narrower than the width of the anterior margin. However, the shield in *S. maureri* sp. n. is more similar to the one found in *S. williamsae* because both are medially fused. Their main differences are in the relative shield's size, radial ribs' development, and on the relative depth of the fan's lateral and median notches. In *S. maureri* the shield is proportionally larger (body length: shield length 7.0:2.5 mm, one paratype Sta. 77, 6.5:2.5 mm), the ribs are better developed, the median notch is shallow or very slightly developed, and the lateral notches are better developed, whereas in *S. williamsae* the shield is smaller (7.5:1.6 mm), the ribs are poorly developed, its median notch is deep or well defined, and the lateral notches are poorly developed or indistinct.

Distribution. Abyssal sediments off Peru, Eastern Pacific, in 1296–6489 m water depths, and in the Southwestern Pacific in 795–3830 m.

***Sternaspis uschakovi* sp. n.**
http://zoobank.org/493904C2-D6D2-47FC-95D0-0A0A2221218D
http://species-id.net/wiki/Sternaspis_uschakovi
Figures 7, 8

Sternaspis scutata: Uschakov 1950:215, 1953:154 (distr., *non* Ranzani 1817, *partim*).
Sternaspis fossor: Fauchald 1972:238–239 (*partim*, *non* Stimpson 1853); Méndez 2007:609, 613–616 (lists) (*partim*, *non* Stimpson 1853).

Type material. Northwestern Pacific Ocean. Holotype (ZIRAS 50604) and 15 paratypes (ZIRAS 50605), Okhotsk Sea, R.V. Gagara, Sta. 251 (55°13'N, 146°52'E), 592 m, 12 Sep. 1932 (four complete paratypes exposing their introvert 5–8 mm long, 4.0–5.5 mm wide, abdomen 3.5–5.0 mm long, left ventro-caudal shield plate 1.0–1.6 mm long, 1.5–2.0 mm wide).

Additional material. Northwestern Pacific Ocean. 12 specimens (ZIRAS 50606) Okhotsk Sea, R.V. Gagara, Sta. 215 (49°25'N, 152°00'E), 1366 m, 8 Aug. 1932 (10 specimens with exposed introvert 10.0–13.0 mm long,4.0 mm wide (waist), abdomen 4.0–5.5 mm long, left ventro-caudal shield plate 2.0–2.5 mm long, 2.0–2.8 mm wide). Three specimens (ZIRAS 50607) juveniles, Okhotsk Sea, R.V. Gagara, Sta. 214 (49°23'N, 148°46'E), 1076 m, 6 Aug. 1932 (juveniles with a very thin shield; abdomen 4.5 mm long, one with introvert partially exposed 7 mm long). **Northeastern Pacific Ocean**. Oregon. Three specimens (CAS 149923) previously dried out, BMT-554 (47°49.9'N, 127°2.9'W), 2510 m, 8 Sep. 1971, A. Carey, coll. (8.0–10.5 mm long, 3–5 mm wide; left shield plate 2.2–2.5 mm long, 2.9–3.0 mm wide). **California.** Nine specimens (SIORAS 4214), R.V. Vityaz, Cruise 29, Sta. 4214 (35°01.5'N, 121°42.5'W), 1585 m, 6 Dec. 1958 (best preserved specimen 12 mm long, 3.4 mm wide (waist), abdomen 8.6 mm long). **Gulf of California**. One specimen (UNAM 7879), introvert broken, off Ensenada del Pabellón, Sinaloa, RV El Puma, Cruise Talud IV, Sta. 19 (24°15'18"N, 108°24'06"W), 1245 m, 25 Aug. 2000 (5 mm long, abdomen 2.8 mm wide; ventro-caudal shield reddish, bent dorsally, wider than abdomen; fan projected medially, posterior margin dentate, last lateral chaetal bundles about 3 mm long). One specimen (UNAM 7880), introvert broken, RV El Puma, Cruise Talud IV, Sta. 26 (24°56'24"N, 109°05'36"W), 1200–1274 m, 26 Aug. 2000 (5.5 mm long, abdomen 2 mm wide; ventro-caudal shield broken, reddish, bent dorsally, wider than abdomen; fan projected medially, posterior margin dentate; last lateral chaetal bundles about 3 mm long). Three specimens (UNAM 7884), two complete, introvert exposed; off Lechugilla Island, Sinaloa, RV El Puma, Cruise Talud IV, Sta. 34 (25°43'50"N, 109°53'59"W), 1240–1270 m, 17 Mar. 2001 (6.3–11.0 mm long, abdomen 3.0–4.5 mm wide; ventro-caudal shield reddish, bent dorsally, wider than abdomen in one specimen; fan projected medially, posterior margin dentate; last lateral chaetal bundles about 3.5 mm long). **Western Mexico.** Eight specimens (LACM 5347), juveniles, most with introvert invaginated or damaged, some with body wall broken, S off Cabo Corrientes, Jalisco, R.V. Velero IV, Sta. 13755 (19°51'30"N,

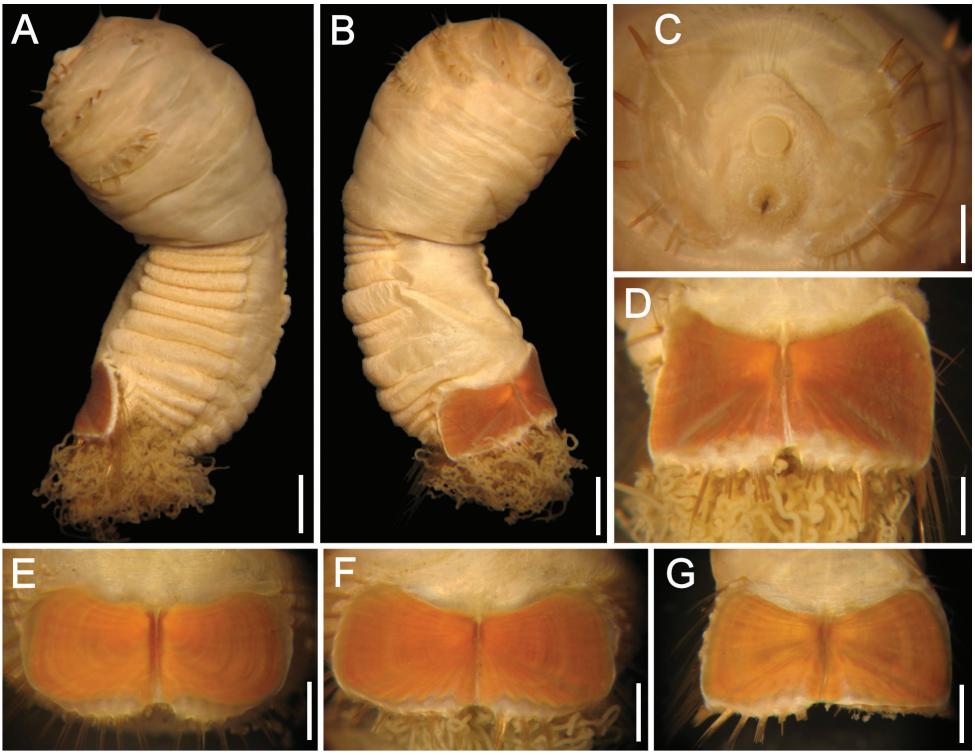

Figure 7. *Sternaspis uschakovi* sp. n. **A** Holotype (ZIRAS 50604), lateral view **B** Oblique ventral view **C** Anterior end, frontal view **D** Ventro-caudal shield, frontal view **E**–**F** Paratypes, ventro-caudal shields, frontal view **G** Non-type specimen (ZIRAS 50606), ventro-caudal shield, frontal view. Bars: **A** 1.7 mm **B** 1.2 **C** 0.8 mm **D** 1.5 mm **E** 0.5 mm **F** 0.9 mm **G** 1.2 mm.

105°50'00"W), 2548 m, mud, Campbell grab, 18 Jan. 1970 (4.0–5.0 mm long, 2.0 mm wide; left shield plate 0.8–1.3 mm long, 1.5–1.8 mm wide).

Description. Holotype (ZIRAS 50604) with body anteriorly swollen, slightly darker than posterior region; introvert fully exposed, pale, abdomen creamy (Fig. 7A), ventro-caudal shield dirty reddish, with orange central areas (Fig. 7B, D). Body 14 mm long, 5 mm wide (mid body constriction), abdomen 9 mm long, left ventro-caudal shield plate 2.2 mm long, 2.7 mm wide. Introvert mostly smooth, barely papillose, abdomen papillae mostly eroded, some retained in folds or around branchial region.

Prostomium hemispherical (Fig. 7C); projected, with same pigmentation as introvert. Eyespots not seen. Peristomium round with abundant papillae restricted to peripheral areas around the mouth, barely reaching margin of first chaetiger.

Introvert chaetigers with 9–11 golden, barely falcate hooks, each with subdistal dark areas but tips mostly eroded (Fig. 7C). Genital papillae small, thin, blunt, with same pigmentation than introvert, in intersegmental groove between segments 7 and 8.

Anterior abdomen with 7 segments, lateral lobes well-defined by contraction, dorsal area bare, converging posteriorly, ventral area bare, more or less parallel; papil-

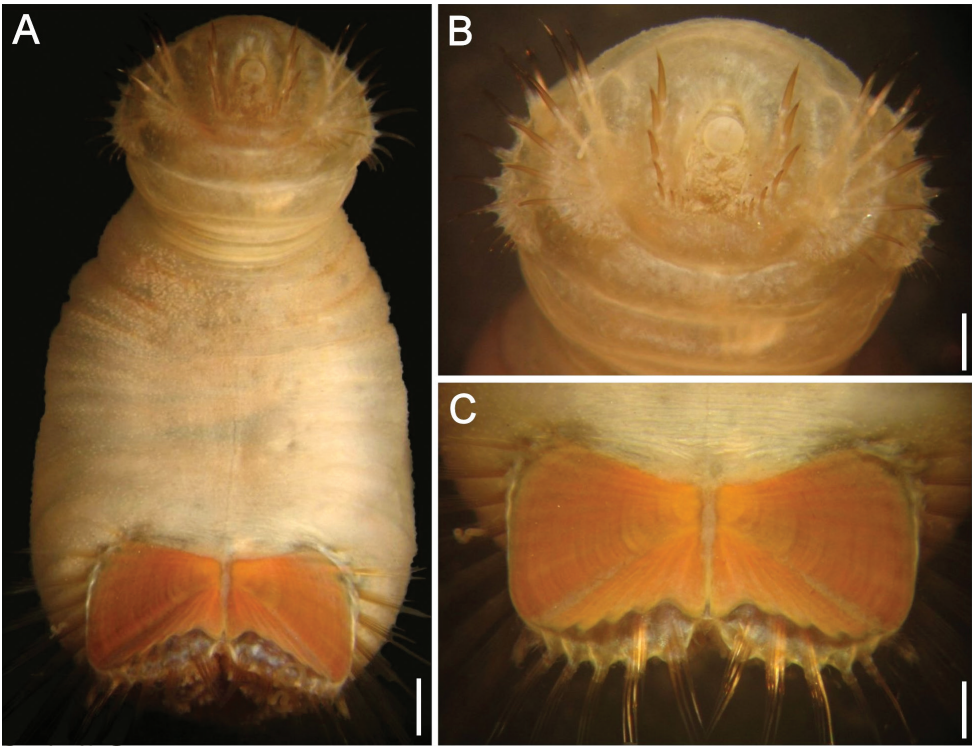

Figure 8. *Sternaspis uschakovi* sp. n., specimen from off Central California, U.S.A. (SIORAS 4214) **A** Frontal view, body ventrally bent **B** Anterior end, frontal view **C** Ventro-caudal shield, frontal view. Bars: **A** 1 mm **B** 0.5 mm **C** 0.6 mm.

lae mostly eroded, some remaining in branchial region, but not arranged in series or groups. Capillaries not seen.

Ventro-caudal shield with lateral plates slightly bent dorsally, making them look quadrate in frontal view (Fig. 7D) but each plate wider than long (Fig. 7B); suture visible throughout shield. Ribs barely developed, concentric lines poorly developed but present. Anterior margins barely rounded, midventral depression shallow. Lateral margins gently rounded, expanded posteriorly. Fan projected medially beyond posterior corners, margin denticulate.

Marginal chaetal fascicles mostly broken off (Fig. 7A, B, D), 9 lateral ones with chaetae along an oblique series, and 6 posterior fascicles with chaetae in linear arrangement. Peg chaetae not visible (some paratypes have them).

Branchiae still attached, abundant, spirally bent filaments; interbranchial papillae long, spirally bent, with fine sediment particles. Branchial plates observed in some paratypes, wide, progressively wider towards anterior margin, with 7–8 filaments per series.

Etymology. This species is being named after the late Dr. Pavel V. Uschakov as a modest homage to his monographic publications, especially those regarding the Okhotsk

Sea fauna, and by his other numerous publications on polychaetes. The epithet is a noun in the genitive case.

Variation. The introvert is markedly swollen, like in the holotype, in one paratype and in some non-type specimens. Introvert chaetigers with 9–10 hooks per bundle. The ventro-caudal shield is dirty orange to pale brick red, ribs and concentric lines are always visible but variably developed; anterior margins rounded to barely acute (Fig. 7E–G); fan markedly projected medially, with shallow lateral notches, margin denticulate rarely reaching the level of the posterior corners. The inner margins of each lateral shield plate are fused along most of its length. The shield chaetal bundles are difficult to count but there are 9 lateral and 7 posterior bundles in better preserved paratypes. On the other hand, the specimens from the Northeastern Pacific have bodies with larger, more abundant papillae (Fig. 8A), and they are also evident in the mouth region (Fig. 8B); the ventro-caudal shield (Fig. 8C), however, is very similar to the specimens from the Northwestern Pacific. We regard the apparent difference in integument papillation as a result of different sampling and sorting procedures and not as a significant, diagnostic difference. Therefore, we conclude they are conspecifics.

Remarks. *Sternaspis uschakovi* sp. n. differs from other deep-sea *Sternaspis* species because its ventro-caudal shield is medially projected, but resembles two other species having a ventro-caudal shield with denticulated posterior margin: *S. africana* Augener, 1918, and *S. andamanensis* Sendall & Salazar-Vallejo, 2013. However, these two species have been found in shallow water (5–70 m), whereas *S. uschakovi* was found in water depths of 592–2548 m. There are two other differences when this new species is compared to the other two; first, the midventral depression is shallow in the new species, resembling *S. africana*, whereas it is deep in *S. andamensis*; and second, the fan posterior margin has two lateral deep notches in *S. andamanensis* whereas in *S. uschakovi* and in *S. africana* the fan is not so markedly notched laterally. Further, as indicated in the key below, *S. uschakovi* is more similar to *S. andamanensis* but they can be easily separated because in *S. uschakovi* there are about 10 dark introvert hooks per bundle, whereas in *S. andamanensis* there are about 15 pale introvert hooks per bundle.

Distribution. Okhotsk Sea in 592–1366 m, California in 1585 m, Gulf of California in 1200–1274 m, and off Western Mexico in 2548 m, in mud or muddy sands.

***Sternaspis williamsae* sp. n.**

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http://species-id.net/wiki/Sternaspis_williamsae
Figures 9, 10

Sternaspis fossor: Hartman 1963:59; Fauchald and Hancock 1981:35 (*partim, non* Stimpson 1853).

Type material. Northeastern Pacific, Oregon. Holotype (LACM 5353), and five paratypes (LACM 5354), off Columbia River, R.V. Acona, Sta. AD 33, NAD 21

(44°30.0'N, 125°34.0'W – 44°39.0'N, 125 33.2 W), 2800 m, 25 Jan. 1963 (paratypes 2.2–9.8 mm long, 1.4–4.5 mm wide, abdomen 2.2–6.0 mm long; left shield plate 0.9–1.8 mm long, 0.8–2.2 mm wide).

Additional material. Northeastern Pacific, Oregon. One specimen (CAS 129027w), Sta. BMT 557 (48°9.0'N, 127°4.2'W), 2519 m, 10 Sep. 1971, A. Carey, coll. (9 mm long, 4.8 mm wide; left shield plate 2.0 mm long, 1.8 mm wide). One specimen (LACM 5359), too damaged, broken into two pieces, shield almost completely lost, off Columbia River, R.V. Acona, Sta. AD 9, NAD 21 (44°36.4'N, 125°24.8'W), 2800 m, 13 Aug. 1962. One specimen (LACM 5355), off Columbia River, R.V. Acona, Sta. AD 32, NAD 19 (44°38.6'N, 125°20.1'W – 44°37.6'N, 125°21.0'W), 2400 m, 25 Jan. 1963 (4.5 mm long, 2 mm wide, abdomen 3 mm long; left shield plate 1.1 mm long, 0.9 mm wide). Two specimens (LACM 5358), juveniles, Cascadia Abyssal Plain, W off Yaquina Bay, R.V. Acona, Sta. AD 141, NAD11B NAD 19 (44°38.6'N, 125°20.1'W – 44°37.6'N, 125°21.0'W), 2400 m, clayey silt, 8 Apr. 1965 (3.5–4.0 mm long, 2.0–2.5 mm wide, abdomen 2.5–3.0 mm long; left shield plate 0.5–0.7 mm long, 0.5–0.9 mm wide). One specimen (LACM 5356), juvenile, too contracted, introvert damaged, Cascadia Abyssal Plain, W off Yaquina Bay, R.V. Acona, Sta. AD 148, NAD 12 (44°40.7'N, 125°10.0'W – 44°41.1'N, 125°10.0'W), 1000 m, 5 Jun. 1965 (genital papillae small, digitate; body 2 mm long, 2.2 mm wide, left shield plate 0.6 mm long, 0.8 mm wide). Five specimens (LACM 5357), juveniles, Cascadia Abyssal Plain, W off Yaquina Bay, R.V. Acona, Sta. AD 149, NAD 15 (44°41.2'N, 125°15.0'W – 44°91.9'N, 125°15.1'W), 1600 m, silty sand, 5 Jun. 1965 (0.7–4.5 mm long, 0.8–3.0 mm wide, abdomen 0.6–3.0 mm long; left shield plate 0.4–0.6 mm long, 0.5–0.9 mm wide). **Northeastern Pacific, Southern California, canyons.** Fifteen specimens (LACM 5363), juveniles, 4.9 km off Gull Island, Santa Cruz Island, R.V. Velero IV, Sta. 6808 (33°54'30"N, 119°47'22"W), green sandy mud, 878 m, 22 Dec. 1959 (3.0–5.0 mm long, 1.5–3.0 mm wide, abdomen 2.0–3.0 mm long; left shield plate 0.5–0.8 mm long, 0.5–0.8 mm wide). Five specimens (LACM 5364), two juveniles, 10.7 km off Ribbon Rock, Santa Catalina Island, R.V. Velero IV, Sta. 6828 (33°20'30"N, 118°39'05"W), green mud, 1246 m, 28 Jan. 1960 (3.0–6.5 mm long, 2.0–3.0 mm wide, abdomen 2.0–3.5 mm long; left shield plate 0.7–0.9 mm long, 0.8–1.1 mm wide). **BLM (= Bureau of Land Management) Baseline Study, Southern California Bight.** One specimen (LACM 5327), dried out, BLM 81202, R.V. Thomas G. Thompson, Sta. 812 (33°46.384'N, 119°35.818'W), 1419 m, olive green soupy mud, biological box core, rep. 2 BFI/ B3-5, 22 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5328), bent over itself, body wall broken, BLM 81236, R.V. Thomas G. Thompson, Sta. 812 (33°46.25'N, 119°36.30'W), 1419 m, olive green soupy mud, biological box core, rep. 36 BFI/ B3-5, 31 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5329), body wall broken, BLM 81237, R.V. Thomas G. Thompson, Sta. 812 (33°46.24'N, 119°36.25'W), 1419 m, olive green soupy mud, biological box core, rep. 37 BFI/ B3-5, 31 Aug. 1977, K. Fauchald, G. Jones, coll. (4 mm long, 3 mm wide, abdomen 3.5 mm long, left shield plate 1 mm long, 1 mm wide). Two specimens (LACM 5330), one with introvert invaginat-

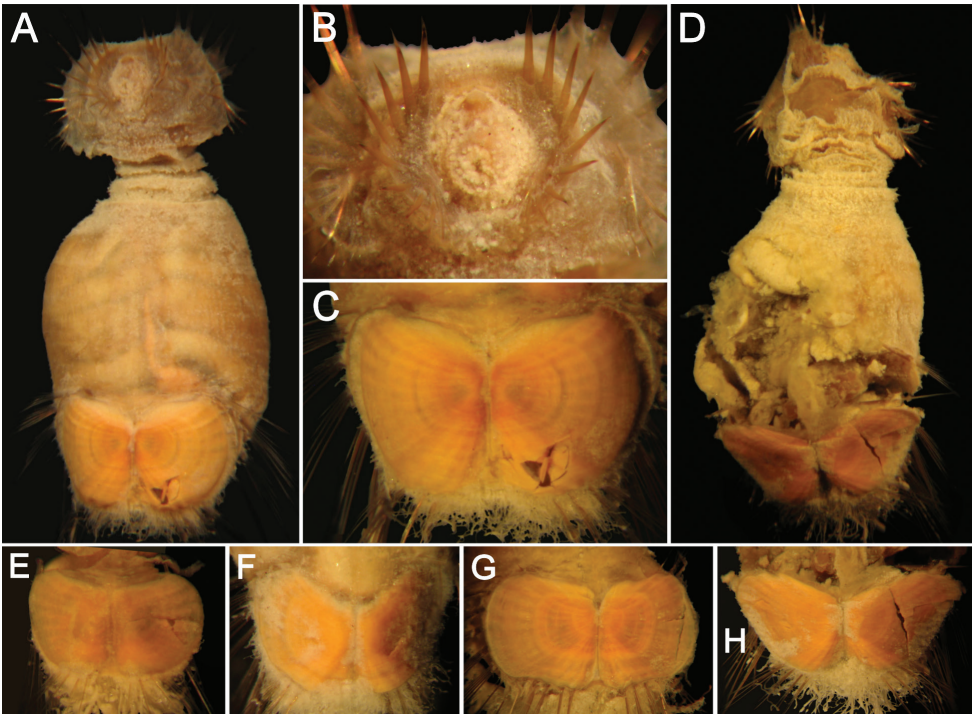

Figure 9. *Sternaspis williamsae* sp. n., holotype (LACM 5353) **A** Frontal view **B** Anterior end, oblique frontal view **C** Ventro-caudal shield **D** Largest paratype (LACM 5354), ventral view **E**–**H** Ventro-caudal shields, frontal view. Bars: **A, G** 0.9 mm **B, H** 1 mm **C** 0.5 mm **D** 1.2 mm **E** 0.4 mm **F** 0.6 mm.

ed, BLM 81238, R.V. Thomas G. Thompson, Sta. 812 (33°46.24'N, 119°36.26'W), 1419 m, olive green soupy mud, biological box core, rep. 38 BFI/ B3-5, 31 Aug. 1977, K. Fauchald, G. Jones, coll. (5 mm long, 2 mm wide, abdomen 3 mm long, left shield plate 1 mm long, 1 mm wide). One specimen (LACM 5331), BLM 81302, R.V. Thomas G. Thompson, Sta. 813 (33°46.24'N, 119°36.26'W), 1758 m, olive brown silty mud, biological box core, rep. 02 BFI/ B4-1, 23 Aug. 1977, K. Fauchald, G. Jones, coll. (abdomen 3 mm long, 3 mm wide; left shield plate 1 mm long, 1 mm wide). Three specimens (LACM 5332), one mature female, BLM 81303, R.V. Thomas G. Thompson, Sta. 813 (33°0.951'N, 119°1.987'W), 1756 m, olive brown silt, biological box core, rep. 03 BFI/ B4-1, 23 Aug. 1977, K. Fauchald, G. Jones, coll. (abdomen 1.8–2.5 mm long, 1.5–2.0 mm wide; left shield plate 0.4–0.8 mm long, 0.5–0.8 mm wide; oocytes 180–200 µm in diameter). Two specimens (LACM 5332a), dried-out, BLM 81305, R.V. Thomas G. Thompson, Sta. 813 (33°1.003'N, 119°1.977'W), 1758 m, olive brown silt, biological box core, rep. 05 BFI/ B4-1, 23 Aug. 1977, K. Fauchald, G. Jones, coll. Two specimens (LACM 5338), BLM 81402, R.V. Thomas G. Thompson, Sta. 814 (32°48.483'N, 119°7.909'W), 931 m, olive green silty mud with shells, biological box core, rep. 02 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. (5 mm long, 2.5–2.8 mm wide, abdomen 3.0–3.5 mm long,

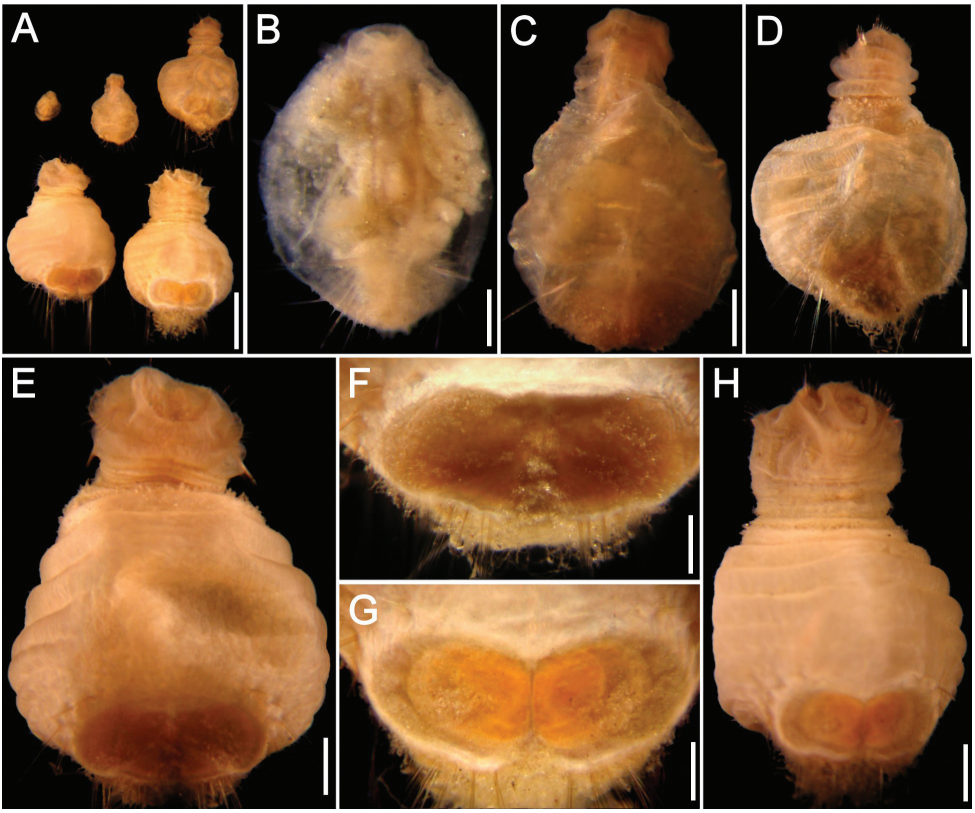

Figure 10. *Sternaspis williamsae* sp. n. Juveniles (LACM 5357) **A** Complete specimens, ventral view **B** Smallest juvenile, ventral view **C** Second specimen, ventral view **D** Intermediate-sized juvenile, ventral view **E** Second largest specimen, ventral view **F** Same, ventro-caudal shield, oblique illumination **G** Largest specimen, ventral view **H** Same, ventro-caudal shield, incident illumination. Bars: **A** 1.4 mm **B** 0.1 mm **C** 0.2 mm **D, G** 0.6 mm **E** 0.5 mm **F, H** 0.3 mm.

left shield plate 0.7–0.9 mm long, 0.7–0.9 mm wide). One specimen (LACM 5339), BLM 81404, R.V. Thomas G. Thompson, Sta. 814 (32°48.481'N, 119°7.872'W), 933 m, olive green silty mud, biological box core, rep. 04 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. (3 mm long, 2 mm wide, abdomen 2 mm long, left shield plate 0.6 mm long, 0.6 mm wide). Two specimens (LACM 5341), dried-out, BLM 81407, R.V. Thomas G. Thompson, Sta. 814 (32°48.465'N, 119°7.946'W), 922 m, olive green silty mud, biological box core, rep. 07 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5342), dried-out, BLM 81408, R.V. Thomas G. Thompson, Sta. 814 (32°48.440'N, 119°7.828'W), 940 m, olive green silty mud, biological box core, rep. 08 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. Two specimens (LACM 5343), dried-out, BLM 81418, R.V. Thomas G. Thompson, Sta. 814 (32°48.53'N, 119°7.89'W), 920 m, olive green silty mud, biological box core, rep. 18 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. Two

specimens (LACM 5344), dried-out, BLM 81422, R.V. Thomas G. Thompson, Sta. 814 (32°48.48'N, 119°7.81'W), 920 m, olive green silty mud, biological box core, rep. 22 BFI/ B4-2, 24 Aug. 1977, K. Fauchald, G. Jones, coll. One specimen (LACM 5345), BLM 82502, 14 km S of Huntington Beach, R.V. Thomas G. Thompson, Sta. 825 (33°33.035'N, 118°0.820'W), 250 m, olive green gray silty clay mud, biological box core, rep. 2 BFI/ B6-2, 3 Feb. 1977, K. Fauchald, G. Jones, coll. (abdomen 3 mm long, 2.3 mm wide; left shield plate 0.8 mm long, 0.8 mm wide). One specimen (LACM 5346), dried-out, BLM 84005, R.V. Thomas G. Thompson, Sta. 840 (33°24.56'N, 119°30.12'W), 713 m, olive green silty mud, biological box core, rep. 5 BFI/ D2-1, 3 Feb. 1977, K. Fauchald, G. Jones, coll.

Description. Holotype (LACM 5353) with body brownish, paler over remaining integument with papillae (Fig. 9A). Introvert exposed, narrower than abdomen, covered with abundant papillae, eroded in some areas. Abdomen with integument smooth without papillae in swollen areas, otherwise with abundant small papillae. Body 7.5 mm long, 3.7 mm wide, abdomen 5.5 mm long; about 29 segments; left shield plate 1.6 mm long, 1.5 mm wide.

Prostomium small ovoid, paler distally, darker basally (Fig. 9B), smaller than mouth. Peristomium rounded, with a band of abundant papillae not reaching base of introvert hooks of chaetiger 1. Mouth oval, slightly projected, papillose.

First three chaetigers with 12–14 bronze, slightly falcate hooks per bundle, each with subdistal dark areas. Genital papillae lost, eroded from the intersegmental groove between segments 7 and 8 (not visible in paratypes either).

Pre-shield region with 7 segments, with papillae abundant in protected areas (some paratypes with papillae arranged in single transverse series per segment). Short, few capillary chaetae present in one segment (in up to three segments in paratypes).

Ventro-caudal shield pale orange (Fig. 9C), with ribs, concentric lines poorly developed; suture distinct throughout shield. Anterior margins rounded; anterior depression deep; anterior keels exposed (also exposed in two paratypes). Lateral margins rounded, reduced posteriorly. Fan truncate, half as wide as anterior margins width, slightly projected beyond posterior shield corners, median notch moderate, fan margin smooth (barely crenulated in two paratypes).

Marginal chaetal fascicles include 10 lateral ones; chaetae ovally arranged, and 5 posterior fascicles (6–7 in paratypes). Peg chaetae or associated capillaries not visible (neither in paratypes).

Branchiae lost in holotype (paratypes with abundant filaments, some 2–3 times thicker, and half as long as the others). Branchial plates parallel, anteriorly rounded.

Variation. There are several modifications in the shield development with roughly defined ribs and the general outline has lateral margins rounded, medially expanded, some distortions were noticed probably due to sample handling since the body is rather delicate. The shield pigmentations is dark yellow in smaller paratypes (Fig. 9E) with radial ribs barely visible and no concentric lines; the posterior margin is smooth with the fan not projected beyond the posterior corners. Slightly larger paratypes have a better defined diagonal rib (Fig. 9F), but concentric lines appear later (Fig.

9G), together with slight lateral notches. The largest paratype was severely damaged (Fig. 9D), and its shield is almost completely detached and bent dorsally, such that its outline is apparently different (Fig.9H); it has a well-developed diagonal rib but concentric lines are barely visible, and the lateral notches are not as distinct as in smaller specimens.

Early shield development. Very small juveniles show a transition in pigmentation and development of the ventro-caudal shield (Fig. 10A). The smallest specimen, being 0.7 mm long (Fig. 10B) has no pigmentation but chaetae are already arranged in lateral and posterior bundles, each with 1–3 chaetae. When the body doubles its size, being about 1.5 mm long (Fig. 10C) the shield has some sediment particles and becomes slightly more pigmented than in smaller specimens. The following stage, when the body reaches about 3 mm long (Fig. 10D), is not markedly different from the previous stage. Darker pigmentation and better defined shield margins are attained when the specimens are 3.5 mm long (Fig. 10E, oblique illumination resulted in a darker shield) but the ribs or the median notch are not well defined. These last two modifications apparently appear soon afterwards because in a similar-sized specimen (Fig. 10H), the shield (with a more incident angle) shows a dark yellow shield bordered by a paler region, and with better defined ribs and median notch (Fig. 10G).

Etymology. This species is named after Susan Williams, in recognition of her taxonomic work on trichobranchids, and because she left some notes indicating that she regarded some of the materials herein included for this description as representing a different pattern which deserved a name. The epithet is a noun in the genitive case.

Type locality. W off Yaquina Bay, Oregon, 2800 m depth.

Remarks. *Sternaspis williamsae* sp. n. is very similar to *S. maior* Chamberlin, 1919 as redescribed elsewhere (Sendall and Salazar-Vallejo 2013) because both have shield with ribs and poorly-developed concentric lines. They differ, however, because of the relative development of some shield features. In *S. williamsae* the main ribs are moderately divergent, and the fan is narrower than that of the anterior margin, being up to half as wide as the anterior margin, whereas in *S. maior* the main ribs are markedly divergent, and the fan is as wide or wider than that of the anterior margin. On the other hand, *S. williamsae* is similar to *S. annenkovae* because both species have shields with fan narrower than that of the anterior margin. These two species differ because in the shield of *S. williamsae* the concentric lines are poorly developed, the fan is medially continuous, and its prostomium is smaller than the mouth, whereas in *S. annenkovae* concentric lines are better developed, the fan is medially discontinuous, and the prostomium is larger than the mouth. As stated above, *S. williamsae* resembles *S. maureri* because of their shields. They differ, however, in three main features. In *S. williamsae* the ribs are poorly developed, its median notch is deep or well defined, and its lateral notches are poorly developed or indistinct, whereas in *S. maureri* the ribs are better developed, its median notch is shallow or very slightly developed, and its lateral notches are better developed.

Distribution. Only known from Oregon to California, 1000–2800 m depth.

Key to species of *Sternaspis* Otto, 1821

(Modified after Sendall and Salazar-Vallejo 2013)

1 Ventro-caudal shield's fan with a distinct median notch **2**
– Ventro-caudal shield's fan continuous, without a distinct median notch..... **9**
2(1) Shield with radial ribs and concentric lines distinct..... **3**
– Shield with radial ribs distinct, concentric lines barely visible..... **7**
3(2) Fan with median notch shallow **4**
– Fan with median notch deep; shields usually with concentric bands **5**
4(3) Shield with distinct concentric bands; main rib and posterior corners directed posteriorly..... ***S. affinis* Stimpson, 1864 (NE Pacific Ocean)**
– Shield without concentric bands; posterior corners directed laterally .... ***S. scutata* (Ranzani, 1817) (Mediterranean Sea and NE Atlantic Ocean)**
5(3) Shield with posterior corners distinct..... ..... ***S. costata* von Marenzeller, 1879 (NW Pacific Ocean)**
– Shield with posterior corners poorly-defined..... 6
6(5) Introvert and body with similar pigmentation or introvert paler; shield widest medially..... ***S. fossor* Stimpson, 1853 (NW Atlantic Ocean)**
– Introvert and body with different pigmentation, introvert darker; shield widest anteriorly..... ***S. annenkovae* sp. n. (NW Pacific Ocean)**
7(2) Main ribs markedly divergent; fan as wide as anterior margins or wider..... ..... ***S. maior* Chamberlin, 1919 (Eastern Pacific, Gulf of California)**
– Main ribs moderately divergent; fan half as wide as anterior margins..... **8**
8(7) Posterior margin truncate, with lateral notches; ribs well-developed..... ..... ***S. maureri* sp. n. (Central Eastern Pacific)**
– Posterior margin with a median notch, lateral notches shallow or indistinct; ribs poorly developed..... ***S. williamsae* sp. n. (Northeastern Pacific)**
9(1) Fan margin crenulated, not projected posteriorly..... **10**
– Fan margin denticulate, medially projected..... **14**
10(9) Shield with ribs and concentric lines..... **11**
– Shield with ribs; concentric lines indistinct..... ..... ***S. princeps* Selenka, 1885 (SW Pacific Ocean, New Zealand)**
11(10) Shield anterior margins rounded..... **12**
– Shield anterior margins acute..... ***S. spinosa* Sluiter, 1882 (Indonesia, Java)**
12(11) Shield with posterior corners distinct..... **13**
– Shield with posterior corners indistinct... ***S. rietschi* Caullery, 1944 (Indonesia)**
13(12) Posterior corners barely projected beyond fan margin; introvert hooks thick, bronze..... ...***S. thalassemoides* Otto, 1821 (NE Atlantic Ocean and Mediterranean Sea)**
– Posterior corners projected beyond fan margin; introvert hooks thin, golden..... ... ***S. thorsoni* Sendall & Salazar-Vallejo, 2013 (Indian Ocean, Arabian Gulf)**

14(9) Fan without lateral notches; body papillae arranged in distinct transverse rows. *S. africana* Augener, 1918 (Eastern Atlantic Ocean, Ghana to Angola).

– Fan with lateral notches; body papillae distributed homogeneously, not arranged in transverse rows **15**

15(14) Introvert with about 15 pale hooks per bundle..... ***S. andamanensis* Sendall & Salazar-Vallejo, 2013 (Indian Ocean, Andaman Sea)**

– Introvert with about 10 dark hooks per bundle..... .....***S. uschakovi* sp. n. (Northern Pacific Ocean)**

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RESEARCH ARTICLE

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A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from south western Turkey

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Abstract

A new scorpion species, *Euscorpius lycius* **sp. n.,** is described based on specimens collected from Muğla and Antalya Provinces, in southwestern Turkey. It is characterized by a standard trichobothrial pattern (*Pv*= 8/9, *et*= 6, *em*=4, *eb*= 4), small size and light brown/reddish coloration. With the description of *Euscorpius lycius* **sp. n.**, the number of valid species of the genus *Euscorpius* in Turkey increases to 5.

Keywords

Scorpion, *Euscorpius*, new species, Turkey

Introduction

The genus *Euscorpius* Thorell, 1876 is one of the most studied taxa of scorpions; however, because of its complexity, its taxonomy changes continuously and is not completely clear. The *Euscorpius* populations of Turkey have been poorly studied, but in the last years several studies are delineating the diversification and distribution of the various forms of this genus (e.g. Fet et al. 2003b; Karataş 2006; Tropea et al. 2012;

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Yağmur and Tropea 2013). At present only four valid species are recognized in Turkey (not including the new species): *E. italicus* (Herbst, 1800), *E. mingrelicus* (Kessler, 1874), *E. avcii* Tropea et al., 2012 and *E. rahsenae* Yağmur & Tropea, 2013. *E. mingrelicus*, which is a species complex, has six described subspecies in Turkey [*E. m. mingrelicus* (Kessler, 1874), *E. m. ciliciensis* Birula, 1898, *E. m. phrygius* Bonacina, 1980, *E. m. ollivieri* Lacroix, 1995, *E. m. legrandi* Lacroix, 1995, and *E. m. uludagensis* Lacroix, 1995)] that need clarification.

Presence of the subgenus *Euscorpius* in Turkey have been reported many times under the name of *E. carpathicus* or *E. carpathicus* "complex", from İstanbul (Hadži 1930; Vachon 1951); Havza (Samsun) (Schenkel 1947); Sinop (Tolunay 1959); Amasya, the Middle Taurus, Borçka (Artvin), Çanakkale, Trakya and Efes (İzmir) (Kinzelbach 1975, 1982); Alanya (Antalya), Bursa Town and Gemlik (Bursa), Ayvacık and Çan (Çanakkale), Sarıyer, Üsküdar and Büyükada Island (İstanbul), Urla (İzmir), Fethiye (Muğla), Sinop Town and Ada vicinity (Sinop) (Karataş 2006); and Dilek Peninsula (Aydın) (Koç and Yağmur 2007). Furthermore, Kinzelbach (1975) recorded *E. mesotrichus* from Şile (İstanbul) and Prinkipos Island (Büyükada Island) in the Marmara Sea. Further studies (Di Caporiacco 1950; Fet 1997; Fet and Braunwalder 2000; Gantenbein et al. 2001; Fet and Soleglad 2002; Fet et al. 2003a; Tropea et al. 2012; Tropea and Rossi 2012) reported that *E. mesotrichus* is not an available name, and populations within Kinzelbach's interpretation, referred to other species such as *E. tergestinus*, *E. balearicus, E. sicanus* and other forms.

The new species described herein, *Euscorpius lycius* sp. n., is the third species recognized in Turkey which "falls" in the subgenus *Euscorpius* as it is understood until now; however, in the present study we do not assign a subgeneric level, since that the subgenus *Euscorpius* currently needs depth studies and new dichotomous keys as has been shown in Tropea (2013).

Materials and methods

A total of 26 specimens belonging to the new species were collected from Antalya and Muğla Province, in the south-west of Turkey (Fig. 8). Most of specimens were collected in night time from under pine forest while they were siting on the rocks, cracks and garden walls. Some specimens were collected from under stones in pine forests in day time. Comparison material: *E. avcii*, holotype ♂, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası, Aydın, Turkey, 07.10.2005, leg. H. Koç (MTAS); paratypes, 1 ♂, 5 ♀♀, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası District, Aydın Province, Turkey, 07.10.2005, leg. H. Koç (MZUF); same data, 1 ♂, 2 ♀♀ (GTC); Abbreviations: *V*: trichobothria on ventral pedipalp chela manus; *Pv*: trichobothria on patella ventral surface; *Pe*: trichobothria on the pedipalp patella external surface; *et*: external terminal; *est*: external subterminal; *em*: external medium; *esb*: external suprabasal; eb_a: external basal *a*; *eb*: external basal; DPS: dorsal patellar spur; DD: distal denticle; MD: median

denticles; OD: outer denticles; ID: inner denticles; IAD: inner accessory denticles. Material examined is deposited in the following collections: MZUF: Museo Zoologico 'La Specola' dell'Università di Firenze, Florence, Italy; GTC: private collection of Gioele Tropea, Rome, Italy; MTAS: Museum of the Turkish Arachnological Society; MSNB: Museo Civico di Scienze Naturali "E. Caffi", Bergamo, Italy; ZMSU: Zoology Museum of Sinop University, Turkey; KUAM: Arachnological Museum of Kırıkkale University, Turkey; AZM: Zoology Museum of Alaşehir Vocational School, Celal Bayar University, Manisa, Turkey.

The trichobothrial notations follow Vachon (1974). The morphological measurements are given in millimeters (mm) following Sissom et al. (1990). The morphological nomenclature follows Stahnke (1970), Hjelle (1990), and Sissom (1990); the chela carinae and denticle configuration follows Soleglad and Sissom (2001) and sternum terminology follows Soleglad and Fet (2003); description and terminology of hemispermatophore follows Soleglad and Sissom (2001) and Fet and Soleglad (2002).

Taxonomy

Family Euscorpiidae Laurie, 1896
Genus *Euscorpius* Thorell, 1876

***Euscorpius lycius* sp. n.**
http://zoobank.org/2146A862-414B-4EB7-9FEE-B5CF2B973395
http://species-id.net/wiki/Euscorpius_lycius
Figs 1–7

Type material. Holotype: 1) 1♂, Turkey, Muğla Province, Fethiye District, Faralya Village, 30.05.2012, 36°29'37"N, 29°08'07"E, 349 m, leg. F. Yeşilyurt & E. A. Yağmur (AZM).

Paratypes: 1) 3♀♀, 4♂♂. Muğla Province, Fethiye District, Faralya Village, 30.05.2012, 36°29'37"N, 29°08'07"E, 349 m, leg. F. Yeşilyurt & E. A. Yağmur (KUAM). Same data but 1♀, 1♂ (AZM) 2♀, 2♂ (GTC) 1♀, 1♂ (MSNB).

2) 1♂. Muğla Province, Fethiye District, Babadağ Mountain, 26.06.2013, 36°28'58"N, 29°12'04" E, 1132 m, leg E. A. Yağmur, M. Kesdek & Y. İlemin (AZM).

3) 1♂. Antalya Province, Kaş District, Gömücü Village, 15.05.2012, 36°24'15"N, 29°42'01"E, 976 m, leg. R. Kaya & A. Akkaya (AZM).

4) 2 juv. Antalya Province, Kaş District, İkizce Village, 5 km North, 13.04.2012, 36°21'30"N, 29°29'00"E, 1140 m, leg. E. A. Yağmur & D. Türk (AZM). Same data but 02.06.2012, 5♀♀, 1♂ (AZM), leg. E. A. Yağmur, M. Örgel & D. Türk (Fig. 8).

Etymology. The specific epithet refers to the ancient Latin name of the collection area, which is Lycia.

Diagnosis. A small *Euscorpius* species, total length 21–25 mm. Color of adults light brown-reddish with carapace and pedipalps darker. The number of trichobothria

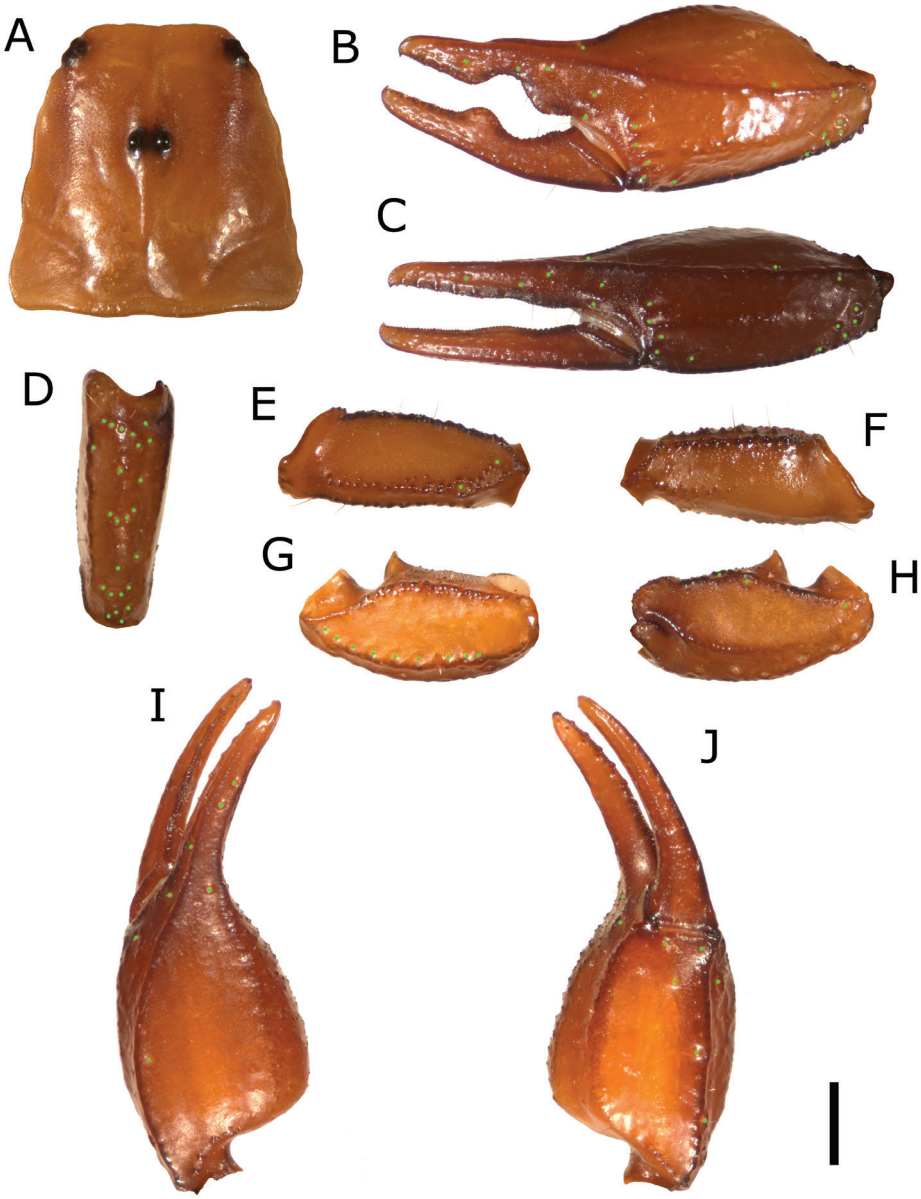

Figure 1. A carapace **B** external view of chela of the adult male **C** external view of chela of the adult female **D** external view of pedipalp patella **E** dorsal view of pedipalp femur **F** ventral view of pedipalp femur **G** ventral view of pedipalp patella **H** dorsal view of pedipalp patella **I** dorsal view of chela **J** ventral view of chela. (Scale bar= 1 mm).

on the pedipalp manus ventral surface is 4 (3 *V* + *Et* 1); the number of trichobothria on the pedipalp patella ventral surface usually is 9 (in 86.54% of examined pedipalps); the number of trichobothria on pedipalp patella external surface usually is: *eb* = 4, eb_a

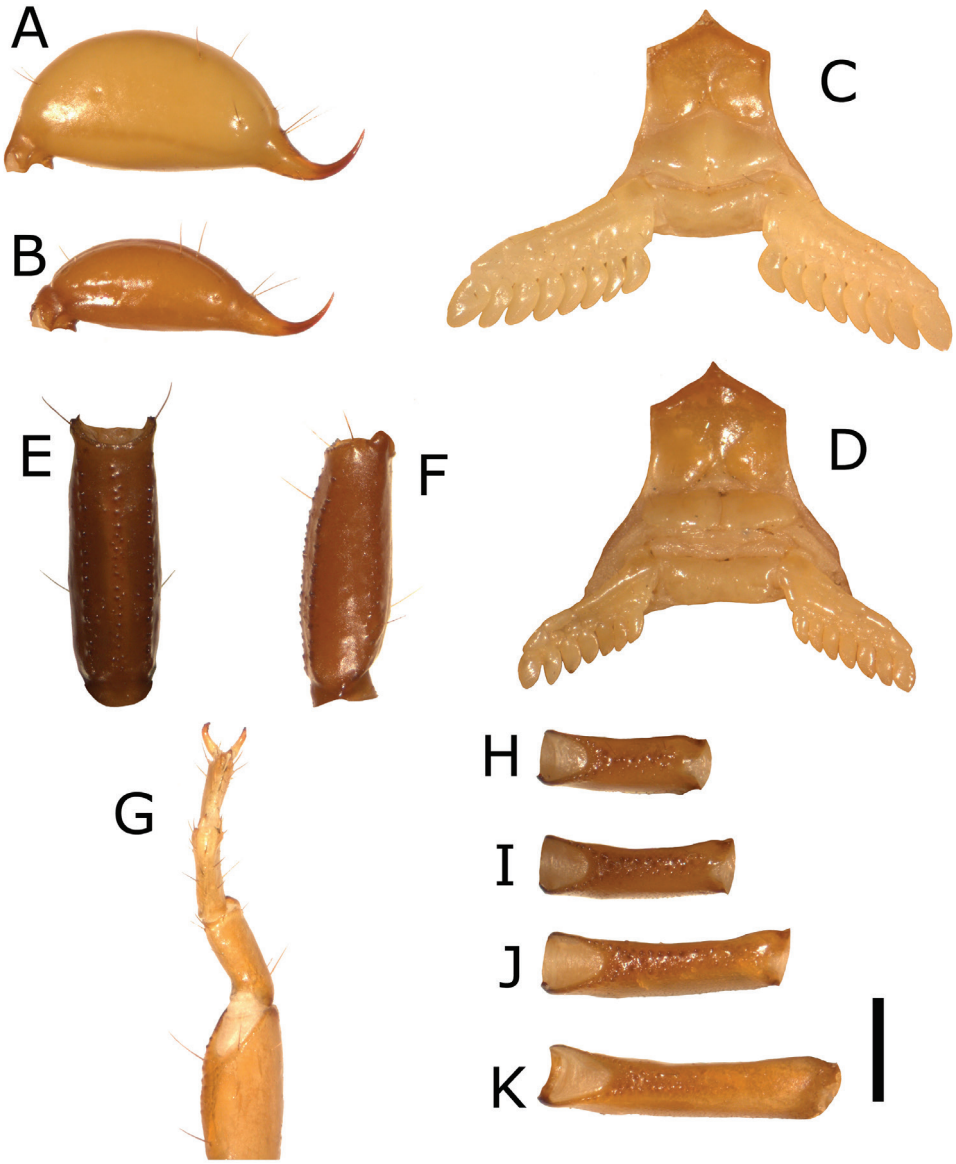

Figure 2. A telson of adult male **B** telson of adult female **C** sternopectinal area of adult male **D** sternopectinal area of adult female **E** ventral view of the metasomal segment V **F** lateral view of the metasomal segment V **G** tarsus and basitarsus **H** leg femur I **I** leg femur II **J** leg femur III **K** leg femur IV. (Scale bar= 1 mm).

= 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 6–7 (*et* = 6 in 53.84% and *et* = 7 in 36.54% of examined pedipalps). The pectinal teeth count usually is 8 (8 in 66.66% and 9 in 29.16% of examined pectines) in males and 7 in females. Dorsal carinae of the metasomal segments I–IV granulated. Chela with a notch on fixed finger and scalloping of the

Figure 3. Dorsal and ventral views of *Euscorpius lycius* sp. n. male.

Figure 4. Dorsal and ventral views of *Euscorpius lycius* sp. n. female.

movable finger in adult males, obsolete in females. Trichobothrium *et* occurs distally to the notch on the fixed finger, *est* occurs above the notch on the fixed finger and *dsb* occurs proximally to the notch of the fix finger.

Table 1. Measurements (in mm) of male holotype and female paratype of *Euscorpius lycius* sp. n.

		Holotype ♂	Paratype ♀
Total	Length	21.14	20.91
Carapace	Length	3.06	3.48
	Posterior width	3.12	3.42
Metasoma	Length	7.94	7.17
Segment I	Length	0.98	0.96
	Width	1.08	1.08
Segment II	Length	1.20	1.17
	Width	0.91	0.95
Segment III	Length	1.36	1.32
	Width	0.87	0.87
Segment IV	Length	1.63	1.26
	Width	0.84	0.83
Segment V	Length	2.76	2.46
	Width	0.84	0.83
Telson	Length	3.24	2.64
Vesicle	Length	2.52	1.86
	Width	1.20	0.90
	Height	1.26	0.84
Aculeus	Length	0.72	0.78
Femur	Length	2.61	2.82
	Width	0.95	1.08
Patella	Length	2.58	2.82
	Width	1.02	1.23
Chela	Length	5.10	5.58
	Width	1.86	1.98
Movable finger	Length	2.70	3

Description of the holotype male. ***Coloration:*** Very light brown-reddish with carapace and pedipalps darker. Granules on the femora of the legs, especially ventrally, dark. The sternites, pectines and genital operculum are very light brownish-whitish.

Carapace. Length 3.06 mm; posterior width 3.12. Finely granulated. Distance from the center of the median eyes to the anterior margin of the carapace is 39.21% of the prosoma; the length from the center of the median eyes to the posterior margin of the carapace is 60.79% of the prosoma. Length/Posterior width ratio 0.981 (Fig. 1A).

Mesosoma. Tergites finely granulated; sternites smooth. The area of overlap between the sternites is lighter in color. Pectinal teeth count is 9–9. The spiracles are very small and little visible, oval-shaped and it is inclined about 45° downwards towards outside.

Metasoma. Medium size with respect to body length. Dorsal carinae of segment I-IV are granulated, obsolete on the segment V; ventromedian carinae of segment I-III absent, barely visible angularities on the IV, ventromedian carinae on segment V granulated; ventrolateral carinae of segment I absent, on segments II and III obsolete, on segment IV formed by small spaced granules, on segment V is formed by serrulate granules (Fig. 2E, F).

Figure 5. An alive female specimen of *Euscorpius lycius* sp. n.

Figure 6. A male *Euscorpius lycius* sp. n. in its natural habitat.

Telson. Vesicle weakly swollen; smooth, with ventral setae of different sizes; telson height 1.26; telson length 3.24; vesicle length 2.52; vesicle width 1.20; L/H ratio of the vesicle 2 (Fig. 2A, B).

Pectines. Pectinal teeth count 9-9; middle lamellae count 5-5.

Genital operculum. Partially divided with genital papillae protruding.

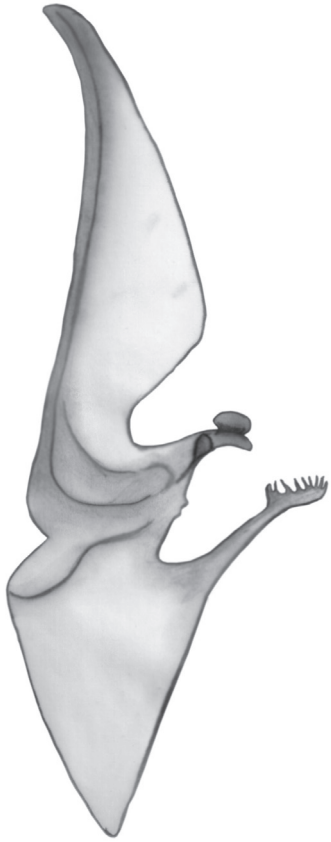

Figure 7. Left hemispermatophore of *Euscorpius lycius* sp. n.

Sternum. Pentagonal shape, type 2. Length similar to width, deep posterior emargination.

Pedipalp. Coxa and trochanter granulated. Femur: dorsal internal carinae formed by large dark tubercles; dorsal external carinae formed by slightly serrulated and spaced tubercles; intercarinal spaces uniformly granulated with fine granules; external median carinae serrulate; anterior median carinae formed by conical big dark tubercles (Fig. 1E, F). Patella length 2.58; patella width 1.02; dorsal internal carinae dark and crenulate with few larger tubercles distally; dorsal and ventral external carinae rough; ventral internal carinae dark and tuberculate; dorsal intercarinal tegument very finely granulated; ventral intercarinal tegument almost smooth with a few scattered very small granules; internal intercarinal tegument uniformly finely granulate. Dorsal patellar spur well developed (Fig. 1G, H). Chelal carina D_1 is distinctly strong, a bit darker and from smooth to rough; D_4 little marked, roughly smooth with a few very low granules; V_1 is distinctly strong, rough and dark; V_3 with a few scattered very minuscule granules; external carina rough; intercarinal tegument from smooth to rough except between carinae D_4 and V_3, granulate. Movable finger dentition: MD form a

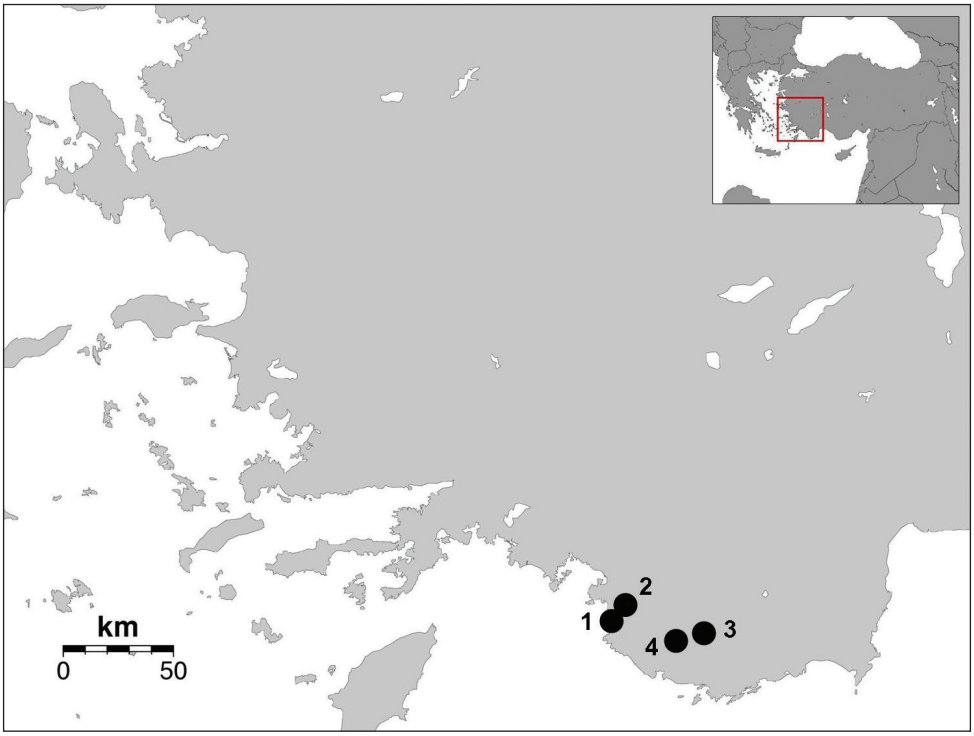

Figure 8. Sampling map of *Euscorpius lycius* sp. n. **1** Muğla, Faralya Village **2** Muğla, Babadağ Mountain **3** Antalya, Gömücü Village **4** Antalya, İkizce Village.

straight line of very small denticles closely spaced with a DD on the distal tip; OD formed of 7 denticles on movable finger and 6 denticles on fixed finger, immediately outside of MD, their size increases progressively but the terminal denticle is not very pronounced; ID formed of 7 denticles on movable finger and 6 denticles on fixed finger, spaced from MD, their size increases progressively but the terminal denticle is not very pronounced; IAD on both movable and fixed finger formed of 4 small denticles; L/W ratio of the chela 2.74 (Fig. 1I, J)

Trichobothria. Chela trichobothria series *V* standard: *V* = 4/4 (3 *V*+ *Et*1); patella ventral (*P*v): 9/9; Patella external (*P*e): *et* = 5/6, *est* = 4/4, *em* = 4/4, *esb* = 2/2, *eba* = 4/4, *eb* = 4/4.

Legs. legs with two pedal spurs. Tarsal ventral row with 10-14 spinules (including the ventral distal spinule); 3 flanking pairs of tarsal setae adjacent to the ventral spinules row. Little marked granulation present above leg femora, a bit more marked on III leg; dark conical tubercles on ventral leg femora.

Chelicerae. smooth, without marbling, uniformly coloured; typical dentition pattern of *Euscorpius* genus (Soleglad and Sissom 2001).

Variation. The variation observed in 26 studied specimens (12 males, 14 females) is as follows (left/right asymmetry not specified). Pectinal teeth in males (n=12): 7/8

(1), 8/8 (6), 8/9 (3), 9/9 (2); 8 in 66.66% and 9 in 29.16%; mean = 8.25, SD = 0.52. Pectinal teeth in females (n=14): 7/7 (12), 8/7 (2); 7 in 92.28% and 8 in 7.72%; mean = 7.07, SD = 0.26. Pedipalp patella trichobothria *Pv* (n=26): 9/10 (1), 9/9 (20), 8/9 (4), 8/8 (1); 9 in 86.54 % and 8 in 11.54 %; mean = 8.90, SD = 0.35. Pedipalp patella trichobothria *Pe* (n=26): *et* = ?/6 (1), 5/6 (3), 6/6 (12), 7/7 (9), 7/8 (1); 6 in 54.90 % and 7 in 37.25 %; mean = 6.35, SD = 0.56. *est* = 4/4 (26); *em* = 4/3 (3), 4/4 (23); *esb*= 2/2 (26); eb_a = 4/3 (2), 4/4 (24); *eb* = 3/4 (1), 4/4 (25). The telson vesicle in males is more swollen than in females: average L/H ratio of the vesicle is 1.93 in male and 2.28 in females. Dorsal patellar spur well developed. Average value of the length from center median eyes to anterior margin of the carapace is 40.30% of the carapace length. Average value of the length from center median eyes to posterior margin of the carapace is 59.70% of the carapace length.

Hemispermatophore. Were checked both right and left hemispermatophore of 5 specimens. Well developed lamina with well developed basal constriction, tapered distally; truncal flexure present and well developed; capsular lobe complex well developed, with acuminate process; ental channel spinose distally, exhibiting 8–11 tines in its crown (Fig. 7). The number of tines of the crown may be different between the right and the left hemispermatophore.

Discussion and comparison

Karataş (2006) reported two populations of the subgenus *Euscorpius* from Turkey as "*Euscorpius* sp.1" and "*Euscorpius* sp.2". The first population has been reported from Bursa, Çanakkale, İstanbul, İzmir, and Sinop Provinces; the second has been reported from Antalya and Muğla Provinces. *E. lycius* sp. n. occurs within the area of the second population (south-west). Karataş (2006) reported that in both "*Euscorpius* sp.1" and "*Euscorpius* sp.2", *V4* was situated on the *ventral* surface, internally from the external ventral carina, but *E. lycius* sp. n. specimens, as well as those from İstanbul that coincide with "*Euscorpius* sp.1" of Karataş (2006), have the trichobothrium *V4* situated on the external surface. It is probable that Karataş (2006) misinterpreted the trichobothrial nomenclature of the chela.

E. lycius sp. n. is "related" to the subgenus *Euscorpius* as it is understood until now, thus clearly distinguished from *E. italicus* and *E. mingrelicus.* However, in the present study we do not assign the subgeneric level, since that the subgenus *Euscorpius* currently needs depth studies and new dichotomous keys as has been shown in Tropea (2013). The only valid species "related" to the subgenus *Euscorpius* in Turkey are *E. avcii* and *E. rahsenae*.

E. avcii was described from Dilek Peninsula as an oligotrichous, small *Euscorpius*, with a length of 24–28 mm, light brown to brown-reddish colored with the carapace and pedipalps darker, and legs and telson lighter (Tropea et al. 2012). These two species are similar in colour and size, although *E. lycius* sp. n. is on average smaller. However, they may be differentiated as follows: (1) *Pv* count is usually 7 in *E. avcii* and 9

in *E. lycius* sp. n.; 2) *Pe-et* series is generally 5 in *E. avcii* and 6 in *E. lycius* sp. n.; (3) *E. avcii* has the metasomal segments almost smooth while *E. lycius* sp. n. exhibits noticeable granulated carinae; (4) dorsal patellar spur weakly developed in *E. avcii*, but well developed in *E. lycius* sp. n.

E. rahsenae was described from Marmara Region as a medium sized *Euscorpius*, total length 27–34 mm, color very light brown-yellowish with carapace and pedipalps a little darker, legs, telson and chelicerae lighter (Yağmur and Tropea 2013). It is possible to differentiate this species from *E. lycius* sp. n. as follows: (1) *Pv* count is usually 8 in *E. rahsenae* and 9 in *E. lycius* sp. n.; (2) *E. lycius* sp. n. has the trichobothria *et-est/est-dsb* on fixed finger more proximal of *E. rahsenae*, in fact in *E. lycius* the trichobothrium *et* occurs distally to the notch on the fixed finger, *est* occurs above the notch on the fixed finger and *dsb* occurs proximally to the notch of the fix finger (similar to *E. avcii*), while in *E. rahsenae et* and *est* occur distally to the notch on the fixed finger and *dsb* occurs above the notch of the fixed finger; (3) *E. lycius* sp. n. is on average smaller than *E. rahsenae* sp. n. (21–25 mm and 27–34 mm, respectively).

Below, we compare *E. lycius* sp. n. with some other forms present in the Aegean area: *E. sicanus* (C. L. Koch, 1837) complex; *E. koschewnikowi* Birula, 1900; *E. candiota* Birula, 1903; *E. scaber* Birula, 1900; *E. ossae* Di Caporiacco, 1950; and *E. c. aegaeus* Di Caporiacco, 1950.

E. sicanus complex is widespread in mainland Greece and some Aegean islands (Fet et al. 2003a; Tropea and Rossi 2012), and can be easily distinguished from *E. rahsenae* sp. n. by the trichobothrial *eb* series, 5 in *E. sicanus* complex and 4 in *E. lycius* sp. n.

E. koschewnikowi is a medium to large sized species (up to 46 mm), medium to dark brown in color, slender appearance with well developed dorsal patellar spur and all metasoma segments longer than wide. In addition, according to Fet and Soleglad (2002) the exceptionally slender and smooth metasoma are key diagnostic characters of this species. *E. lycius* sp. n. mainly differs from *E. koschewnikowi* with a significantly smaller average size; its metasomal segments are not smooth, and the first segment not longer than wide.

E. candiota differs from *E. lycius* sp. n. for: (1) the metasomal carinae on segments II–IV smooth to obsolete (Fet et al. 2013) while *E. lycius* sp. n. has the dorsal carinae of the segment I–IV granulated; (2) *E. candiota* is larger in size, about 40 mm (Fet et al. 2013) versus 21–25 mm in *E. lycius* sp. n. Furthermore *E. candiota* tends has a higher *Pv, Pe-et* and pectinal teeth count in males and it is endemic of Crete island.

E. scaber is a scorpion from the northern Aegean area, it is distinguished from *E. lycius* sp. n. by (1) a higher number of pectinal teeth, *Dp* 10/11 in males and 8 in females (Fet et al. 2013) versus 8 in males and 7 in females in *E. lycius* sp. n.; (2) *E. scaber* has a *Pv* = 8 versus 9 in *E. lycius* sp. n.; (3) *E. scaber* is heavily granulated (Fet 1985; Tropea et al. 2012; Yağmur and Tropea 2013, Fet et al. 2013), as the name suggests and darker, whereas *E. lycius* sp. n. is light brownish-reddish, without particularly accentuated granulation. In addition *E. scaber* occurs in north-east of Greece.

E. ossae is an oligotrichous species, dark brown in colour with lighter legs and telson. It was described from Mount Ossa, in Thessaly. This form can be distinguished

Table 2. Pectinal tooth and trichobothrial counts of *Euscorpius* species discussed in this paper. Between the brackets are the values most found.

Species	*Dp* ♂	*Dp* ♀	*Pv*	*Pe-et*	*Pe-est*	*Pe-em*	*Pe-esb*	*Pe-eba*	*Pe-eb*
E. lycius sp. n.	8	7	9	6–7	4	4	2	4	4
E. avcii	8	7	7	5–6 (5)	4	4	2	4	4
E. rahsenae	9	7	8	5–6 (6)	4	4	2	4	4
E. candiota	8–9	7	9-10	6–7	4	4	2	4	4
E. ossae	9	7	7–8 (7)	5–6 (5)	4	4	2	4	4
E. koschewnikowi	8	6–7	8	5–6	4	4	2	4	4
E. scaber	10–11	8	8	5–6 (6)	4	4	2	4	4
E. c. aegaeus	9	8	8	6	4	4	2	4	4

Table 3. Pectinal tooth and trichobothrial serie *Pv* and *Pe-et* counts of *Euscorpius* species discussed in this paper: max-min (average) {number of pectines and pedipalps examined}.

Species	*Dp* ♂	*Dp* ♀	*Pv*	*Pe-et*
E. lycius sp. n.	7–9 (8.25) {24}	7–8 (7.07) {28}	8–10 (8.90) {52}	5–7 (6.35) {51}
E. avcii	7–9 (8.07) {58}	6–7 (6.79) {100}	6–8 (7.04) {158}	5–6 (5.36) {158}
E. rahsenae	8–10 (8.91) {36}	6–9 (7.20) {82}	7–9 (7.89) {118}	5–6 (5.78) {118}
E. candiota	8–9 (8.60) {16}	5–8 (6.87) {28}	8–10 (9.44) {46}	5–7 (6.52) {46}
E. ossae	8–10 (9.07) {14}	6–8 (7.25) {40}	6–9 (7.29) {55}	4–6 (5.36) {55}
E. scaber	9–13 (10.53) {53}	6–10 (7.85) {212}	7–10 (7.96) {273}	4–8 (5.86) {257}
E. c. aegaeus	9–10 (9.16) {6}	8 (8.00) {4}	7–8 (7.9) {10}	5–6 (5.9) {10}

from *E. lycius* sp. n. mainly by *Pv*=7 and *et*=5, compared to *Pv*=9 and *Pe-et*=6–7 (generally 6) and its dark colour.

E. c. aegaeus is a light colored form described from the island of Antiparos, in the central-southern part of the Aegean Sea. It is probably endemic in few islands in the central-south Aegean Sea. In addition, it is described as uniformly light yellow in colour and females with a pectinal teeth count of 8 with metasomal segments almost smooth (Di Caporiacco 1950), while *E. lycius* sp. n. is light brownish-reddish, pectinal teeth count 7 in females and metasomal segments with granulated carinae.

Ecology

The specimens of *E. lycius* sp. n. were collected between 349 and 1140 m a.s.l. Most of the specimens were collected in night time in the pine forest while they were siting on the rocks, cracks and garden walls. The remaining specimens were collected in day time from under stones in pine forests.

E. lycius sp. n. specimens from Faralya Village were collected on wall stones and garden walls humid in shady places with a lot of stones covered by moss (Fig. 10). This place is at the top of high rocky wall and very close to sea. Other specimens were collected from red pine (*Pinus brutia* Ten.) and Lebanon cedar (*Cedrus libani* A. Rich.)

Figure 9. The forest habitat in İkizce Village.

Figure 10. Habitat in Faralya Village.

forest that also includes kermes oak bushes (*Quercus coccifera* L.), in Gömücü Village and İkizce Village (Antalya Province). These two areas have high elevation, are always cool and are located about ten kilometers from the sea. Babadağ Mountain (Muğla Province) locality has same ecological features with these localities. Therefore these three localities are always humid, they include stones covered by moss.

All localities are humid and cool, with calcareous stones covered with moss, where the specimens of *E. lycius* sp. n. were usually found. We observed that specimens prefer cracks of mossy rocks (Fig. 9). We accept the presence of moss as an indicator during our field trips. Areas with moss are potential places where to find specimens of *Euscorpius*.

Conclusion

Taxonomy of *Euscorpius* genus is complicated and still unresolved throughout its range, because of type specimens lost, lack of specimens from many areas and existence of cryptic species complex, which exhibiting the same, or very similar, standard characters.

The species described herein, *E. lycius* sp. n., is one of those forms of *Euscorpius* with standard characters shared by several species. This condition of cryptic species complex, is known throughout the range of the genus *Euscorpius*, however it is much more expressed in the band that includes Greece and western Turkey. Additional morphological features that simplify the division between the species of the genus *Euscorpius* should be found, but at the moment the only way to identify the various species is to combine a set of characters, primary and secondary, the area of origin and a certain number of specimens available.

Further studies are in progress to understand the quantity and distribution of the different species and populations of the genus *Euscorpius* in Turkey and their relationship with the Greek populations.

With the description of *Euscorpius lycius* sp. n., the number of valid species of the genus *Euscorpius* in Turkey increases to 5.

Acknowledgements

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RESEARCH ARTICLE

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The genus *Aspidimerus* Mulsant, 1850 (Coleoptera, Coccinellidae) from China, with descriptions of two new species

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Abstract

Chinese members of the genus *Aspidimerus* Mulsant, 1850 are reviewed. Ten species are recognized, including two new species: *A. zhenkangicus* Huo & Ren, **sp. n.** and *A. menglensis* Huo & Ren, **sp. n.** *A. kabakovi* Hoàng is recorded from China for the first time. *A. blandus* (Mader, 1954) is recognized as synonymous with *A. ruficrus* Gorham, 1895 **(syn. n.)**. *Aspidimerus rectangulatus* Kuznetsov & Pang, 1991 and *A. serratus* Kuznetsov & Pang, 1991 are transferred to the genus *Pseudaspidimerus* Kapur, 1948 **(comb. n.)**. All species from China are described and illustrated. Distribution maps of the Chinese species, a key and a catalogue of all known *Aspidimerus* are provided.

Keywords

Coleoptera, Coccinellidae, Aspidimerini, *Aspidimerus*, *Pseudaspidimerus*, new species, China

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Introduction

The genus *Aspidimerus* Mulsant, 1850 was erected with *Aspidimerus spencii* from India as the type species by monotypy. Concurrently, another genus *Cryptogonus* Mulsant was erected with *Cryptogonus orbiculus* (Gyllenhal, 1808) as the type species, also by monotypy. At the time of erecting these two genera, Mulsant had only one species for each genus, and separated them by the structure of the prosternum and the labrum which was covered or not by the clypeus. Chapuis (1876) and Weise (1885) considered these characters unreliable and the separation unwarranted as more species became known, and synonymised these two genera: Chapuis kept the name *Cryptogonus* whilst Weise preferred to retain *Aspidimerus*. After examining a large number of specimens, Weise (1900) considered that *Aspidimerus* and *Cryptogonus* were evidently different, based on the structure of male genitalia and consequently revived *Cryptogonus*, but separated them from the Scymnini, and assigned them to the present tribe Aspidimerini. Kapur (1948) revised the tribe Aspidimerini and erected two new genera: *Acarinus* and *Pseudaspidimerus*.

In the revision of the tribe Aspidimerini (Kapur, 1948), only three species of *Aspidimerus* were included: *A. spencii* Mulsant, 1850, *A. ruficrus* Gorham, 1895 and *A. birmanicus* (Gorham, 1895). But Kapur did not study *A. nigrovittatus* Motschulsky, 1866 nor *A. mouhoti* Crotch, 1874, which were listed by Korschefsky (1931) in the Coleopterorum Catalogus. Subsequently, Sasaji (1968) described two species *A. esakii* and *A. matsumurai* from Taiwan, China. Pang and Mao (1979) added another two species *A. sexmaculatus* and *A. decemmaculatus* from Yunnan, China. Hoàng (1982) described four species *A. laokayensis*, *A. dongpaoensis*, *A. chapaensis* and *A. kabakovi* from Vietnam. Yu and Li (2004) added *A. guangxiensis* to the *Aspidimerus* fauna from Guangxi, China.

Recently, Kovář (2007) transferred *Cryptogonus nigritus* Pang & Mao, 1979 and *Cryptogonus blandus* Mader, 1954 to *Aspidimerus*: *Aspidimerus nigritus* (Pang & Mao, 1979) and *Aspidimerus blandus* (Mader, 1954). *Aspidimerus dongpaoensis* Hoàng, 1982 was synonymized with *A. nigritus* (Pang & Mao, 1979) and *A. sexmaculatus* Pang & Mao, 1979 with *A. mouhoti* Crotch, 1874. After examination of the specimens of *A. blandus* (Mader, 1954) collected from the type locality, we found that the characters of the adult, including the male genitalia, perfectly agreed with the descriptions and illustrations of *A. ruficrus* Gorham, 1895 given by Kapur (1948). Therefore, we consider *A. blandus* (Mader, 1954) a junior synonym of *A. ruficrus* Gorham, 1895.

Additionally, Kuznetsov and Pang (1991) described two species *A. rectangulatus* and *A. serratus* from Vietnam. Examination of the type series showed that the characters of the adults, including the male genitalia, are in perfect agreement with the diagnosis of *Pseudaspidimerus* Kapur, 1948. Therefore, these two species are transferred to the genus *Pseudaspidimerus*: *P. rectangulatus* (Kuznetsov & Pang, 1991) (comb. n.) and *P. serratus* (Kuznetsov & Pang, 1991) (comb. n.).

Until now, thirteen species of *Aspidimerus* have been described, all occurring in the Oriental Region. In this paper, ten species of *Aspidimerus* from China are

revised, including two new species: *A. zhenkangicus* Huo & Ren, sp. n. and *A. menglensis* Huo & Ren, sp. n. *Aspidimerus kabakovi* Hoàng is recorded from China for the first time. Diagnoses, detailed descriptions, colored illustrations and distribution maps are provided for each species. A key and catalogue of all known species are also provided.

Materials and methods

The specimens examined were collected and preserved in 90% ethanol. External morphology was observed with a dissecting stereo microscope (SteREO Discovery V20, Zeiss). The measurements were made with an ocular micrometer: total length, from apical margin of clypeus to apex of elytra (TL); total width, across both elytra at widest part (TW=EW); height, through the highest point of elytra to metaventrite (TH); head width, including eyes (HW); pronotal length, from the middle of anterior margin to the base of pronotum (PL); pronotal width at widest part (PW); elytral length, along the suture, from the apex to the base including the scutellum (EL). Male and female genitalia were dissected, cleared in a 10% solution of NaOH by boiling for several minutes, and examined with an Olympus BX51 compound microscope.

Images were photographed with digital cameras (AxioCam HRc and Coolsnap–Pro*cf* & CRI Micro*Color), connected to the dissecting microscope. The software AxioVision Rel. 4.8 and Image–Pro Plus 5.1 were used to capture images from both cameras, and photos were cleaned up and laid out in plates with Adobe Photoshop CS5.

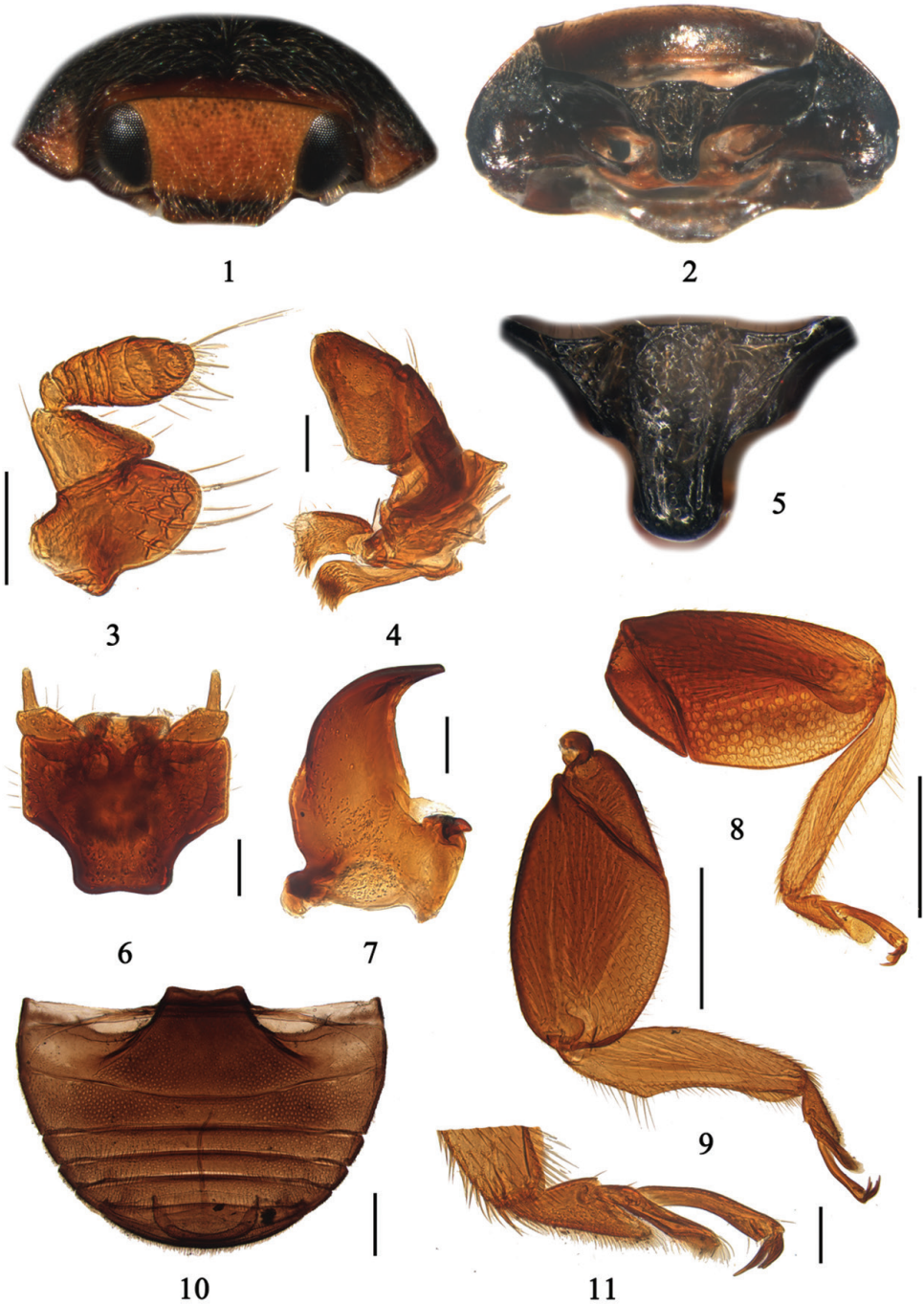
Terminology follows Ślipiński (2007) and Ślipiński and Tomaszewska (2010). Specimens used in this study are deposited in the Department of Entomology, South China Agriculture University, Guangzhou, China (SCAU) and Institute of Zoology, Chinese Academy of Sciences (IOZ).

Taxonomy

Genus *Aspidimerus* Mulsant, 1850
http://species-id.net/wiki/Aspidimerus
Figs 1–11

Aspidimerus Mulsant, 1850: 944. Type species: *Aspidimerus spencii* Mulsant, 1850, by monotypy.

Diagnosis. *Aspidimerus* is closely related to *Cryptogonus* Mulsant. However, it can be easily distinguished from the latter as follows: prosternum T-shaped, evenly convex (Fig. 2), prosternal lines as wide apart as the base of prosternal process; the area between them extremely convex and widening anteriorly to form a chin-band, usually



Figures 1–11. *A. matsumurai* Sasaji, 1986. **1** head, frontal view **2** prothorax, ventral view **3** antenna **4** maxilla **5** prosternal process **6** labium **7** mandible **8** front leg **9** hind leg **10** abdomen **11** tarsi. Scale bars: Figures **1–7, 11**: 0.1mm; Figures **8–10**: 0.5mm.

with coarse punctures and long pubescence (Fig. 5); body moderately large (length 2.8–5.0 mm); oblong oval, moderately convex; pronotum with the posterior angles pointed and lateral margin straight (Fig. 1). The prosternal lines of *Cryptogonus* are not as in *Aspidimerus*, varying in outline, the area enclosed by them lying at the same level as the rest of prosternum; body small, rounded oval.

Description. Body moderately large, oblong oval, dorsum moderately convex, finely punctate and pubescent. Head transverse oval, eyes large, finely faceted, entire, narrowly margined and not extending to underside of head (Fig. 1). Antennae small, geniculate, composed of 8 or 9 antennomeres, antennomere 1 large, 2 slightly smaller and subtriangular, the rest together forming a spindle or an elongate oval club (Fig. 3). Terminal maxillary palpomere securiform (Fig. 4). Pronotum transverse, at middle of length twice as wide as long, strongly convex, anterior margin deeply emarginated. Scutellum subtriangular. Elytra oblong oval, moderately convex. Humeral callus rather prominent, obtusely.

Prosternum T-shaped, evenly convex (Fig. 2), prosternal lines as wide apart as the width of the base of the prosternal process, widely divergent; the area between them extremely convex and widening anteriorly to form a chin-band, usually with coarse punctures and long pubescence (Fig. 5). Both sides of prosternum deeply foveate to accommodate apices of front femora (Fig. 2). Mesoventrite transverse, widely emarginated anteriorly, indistinctly punctate and sparsely pubescent. Metaventrite usually finely punctate, with dense pubescence. Elytral epipleuron narrow, incomplete, with clearly delimited cavities to accommodate apices of mid and hind femora. Abdomen with 6 ventrites, the first being dilated posteriorly in an arc at middle, abdominal postcoxal lines incomplete (Fig. 10). Legs with femora broadly expanded, oval, and completely concealing the compressed tibiae (Figs 8–9), tarsi composed of three tarsomeres (Fig. 11).

Male genitalia: Penis curved, with a distinct penis capsule. Penis guide in ventral view flat and broad, apex pointed or truncate. Parameres slender, with sparsely distributed short setae at apex, nearly as long as penis guide. Female genitalia usually with tenth tergite broad, setose, coxites subtriangular or broad. Spermatheca vermiform, nodulus wide, ramus long.

Distribution. Burma, China, India, Laos, Sri Lanka, Thailand, Vietnam.

Key to species of *Aspidimerus* Mulsant, 1850

1 Ground color of elytra black **2**

– Ground color of elytra yellowish brown or brown **8**

2 Elytra black without any spots, dorsum strongly convex and sparsely pubescent (Figs 12–14). Penis distinctly stout with pointed apex (Fig. 39), penis guide slender with hook-like apex in lateral view (Fig. 42). TL: 3.75mm, TW: 3.00mm, TH: 1.80mm. Distribution: China (Yunnan), Vietnam ..... ***A. nigritus* (Pang & Mao)**

– Elytra black with spots, dorsum moderately convex and densely pubescent..... **3**

3 Elytra black with 4 yellowish brown or red spots **4**

– Elytra black with 2 spots..... **5**

4 Elytra black with 4 yellowish brown spots (Fig. 15). Antennae with 8 antennomeres. Penis relatively long, slender and strongly curved, apex with membranous appendage (Fig. 43). Penis guide broad, widest at basal 1/3 with truncate apex in ventral view. TL: 3.60mm, TW: 2.90mm, TH: 1.75mm. Distribution: China (Hainan, Guangxi, Taiwan)..... ***A. esakii*** **Sasaji**

– Elytra black with 4 red spots. Antennae with 9 antennomeres. TL: 3.60–3.90 mm, TW: 2.90–3.10mm. Distribution: Vietnam..... ***A. chapaensis*** **Hoàng**

5 Penis relatively long, curved almost in a circle in whole length. Penis guide symmetrical with apex arcuate or truncate in ventral view..... **6**

– Penis short, curved at basal 1/3 length. Penis guide asymmetrical, with apex rounded or pointed in ventral view..... **7**

6 Elytra black with 2 yellow spots (Fig. 18). Penis guide moderately broad, symmetrical, almost parallel-sided with arcuate apex in ventral view, distinctly shorter than parameres (Fig. 50). TL: 3.50–3.90mm, TW: 2.65–3.15mm, TH: 1.50–1.75mm. Distribution: China (Yunnan)..... ..... ***A. menglensis*** **Huo & Ren, sp. n.**

– Elytra black with 2 yellowish (in ♂) or reddish brown spots (in ♀). Penis guide narrow, symmetrical, slightly expanded in the middle and narrower towards the apex which is truncate. TL: 3.80–5.00mm, TW: 2.80–3.80mm. Distribution: Burma; Thailand ..... ***A. birmanicus*** **(Gorham)**

7 Elytra black with 2 yellowish brown spots (Fig. 21). Penis guide broad, widest at base, gradually narrowing to the apex, apex with a lateral hook-like process in ventral view (Fig. 54). Penis guide strongly curved, widest at base, strongly narrowing to apex in lateral view (Fig. 55). TL: 2.75–2.80mm, TW: 2.25–2.30mm, TH: 1.55–1.65mm. Distribution: China (Guangxi)..... ..... ***A. guangxiensis*** **Yu**

– Elytra black with 2 red (sometimes yellowish brown) spots (Fig. 24). Penis guide nearly parallel-sided at basal 6/7, then strongly and asymmetrically convergent to a pointed tip in ventral view (Fig. 58). Penis guide stout, spoon-shaped in lateral view (Fig. 59). TL: 3.75–4.60mm, TW: 3.00–3.50mm, TH: 1.65–2.00mm. Distribution: China (Yunnan, Hainan, Taiwan), Vietnam ..... ***A. matsumurai*** **Sasaji**

8 Ground color of elytra brown **9**

– Ground color of elytra yellowish brown..... **10**

9 Body medium size, oblong oval. Upside clear brown with a large black marking in the middle of pronotum. TW: 4.60mm, TW: 3.40mm. Distribution: Vietnam..... ***A. laokayensis*** **Hoàng**

– Body smaller, subrounded. Elytra brown with 4 black spots besides a black sutural spot (Fig. 27). TL: 2.85–3.50mm, TW: 2.40–2.85mm, TH: 1.25–1.75mm. Distribution: China (Guangdong, Guangxi, Yunnan), Vietnam.... ..... ***A. kabakovi*** **Hoàng**

10 Elytra with 8 black spots and a black sutural stripe which expanded at near basal and apical part (Fig. 30). Penis short with penis capsule extremely expanded (Fig. 65). TL: 4.10mm, TW: 3.30mm, TH: 1.46mm. Distribution: China (Yunnan)..... ***A. decemmaculatus*** **Pang & Mao**

– Elytra with 6 black spots and a black sutural stripe which expanded near base (Figs 33, 36). Penis long with penis capsule slightly or moderately expanded **11**

11 Pronotum brown; elytra without the black external border, suture with a narrow, black border between the scutellum and the middle; each elytron with 3 black spots. Distribution: India, Burma ..... ***A. spencii*** **Mulsant**

– Pronotum black; elytra with a narrow black external border all around the margins, that of the suture irregularly expanded in the basal half; each elytron with 3 spots **12**

12 Penis guide stout, strongly curved in lateral view and with obtuse apex in ventral view (Figs 71–72). TL: 4.80mm, TW: 3.60mm, TH: 1.58mm. Distribution: China (Yunnan), Laos (Mouhot) ..... ***A. mouhoti*** **Crotch**

– Penis guide slender, slightly curved in lateral view and with truncate apex in ventral view **13**

13 Sutural stripe irregularly expanded as Fig. 33, the elytral spot nearer the suture as large as the one situated on humeral callus (Fig. 33). Penis capsule slightly expanded (Fig. 73). Penis guide widest at basal 2/5, gradually narrowing to apex, apex truncate in ventral view (Fig. 75). TL: 4.50–4.75mm, TW: 3.40–3.60mm, TH: 2.00–2.25mm. Distribution: China (Yunnan)..... ..... ***A. zhenkangicus*** **Huo & Ren, sp. n.**

– Sutural stripe irregularly expanded as Fig. 36, the elytral spot nearer the suture distinctly larger than that situated on humeral callus (Fig. 36). Penis capsule moderately expanded (Fig. 79). Penis guide widest at middle, gradually narrowing to apex, margins of apical 1/6 almost parallel, apex truncate in ventral view (Fig. 81). TL: 3.75–4.00mm, TW: 3.00–3.25mm, TH: 1.55–1.65mm. Distribution: China (Sichuan, Yunnan), Vietnam, Burma ..... ***A. ruficrus*** **Gorham**

Remarks. *Aspidimerus nigrovittatus* Motschulsky, 1866 is not keyed in the present paper, because the description given by Motschulsky (1866) is too simple to diagnose: "Subovatus, convexus, nitidus, sparsim puberulus, pallide flavus, elytris utrinque vitta lata nigra, apice non attinguenda". Additionally, Kapur (1948) declared that its type was not available.

***Aspidimerus nigritus* (Pang & Mao, 1979)**
http://species-id.net/wiki/Aspidimerus_nigritus
Figs 12–14, 39–42, 85

Cryptogonus nigritus Pang & Mao, 1979: 61; Cao et al. 1992: 138.
Aspidimerus nigritus: Kovář 2007: 71, 73, 575; Ren et al. 2009: 108. Combined by Kovář 2007: 71.
Aspidimerus dongpaoensis Hoàng, 1982: 165. Synonymized by Kovář 2007: 73.

Diagnosis. This is a very distinctive species with body strongly convex and dorsal surface entirely black (Figs 12–14). Penis extremely short and stout (Fig. 39). Penis guide straight with hook-like apex in lateral view (Fig. 42). In ventral view, penis guide nearly parallel at basal half and then converging gradually to a blunted tip (Fig. 41).

Description. TL: 3.75mm, TW: 3.00mm, TH: 1.80mm, TL/TW: 1.25; PL/PW: 0.53; EL/EW: 0.88.

Body oblong oval, strongly convex and sparsely pubescent (Figs 12–14). Head reddish brown, eyes silver white (Fig. 14). Dorsal surface entirely black (Fig. 12). Underside reddish brown, except prosternum, mesoventrite and metaventrite dark brown.

Head small, 0.37 times elytral width (HW/EW=1: 2.73). Punctures on frons sparsely distributed, separated by 1.0–3.0 times their diameter. Eyes large and almost oval, rather finely faceted, the widest interocular distance about 0.50 times head width. Punctures on dorsal surface fine, close, separated by 0.5–2.0 times their diameter, with short, thin pubescence. Pronotum 0.67 times elytral width (PW/EW=1: 1.50). Surface of prosternum coarse, with sparse long pubescence. Mesoventrite with inconspicuous, rather sparse punctation. Punctures on metaventrite moderately large, separated by 0.3–1.0 times their diameter, with dense golden pubescence.

Male genitalia: Penis short, distinctly stout (Fig. 39). Penis capsule with a large outer process and an indistinct inner one (Fig. 39). Apex of penis pointed with membranous appendage (Fig. 40). Penis guide slender with hook-like apex in lateral view (Fig. 42). In ventral view, penis guide nearly parallel at basal half, and then converging gradually to a blunted tip (Fig. 41). Parameres stout, shorter than penis guide, with sparsely distributed long setae at its apex and inner side (Fig. 42).

Female genitalia: Unknown.

Specimens examined. China, Yunnan: 1♂, Menglun, Jinghong, [21°55.51'N, 101°15.45'E], ca 540m, 11.v.2009, Ren SX leg (SCAU).

Distribution. China (Yunnan); Vietnam.

***Aspidimerus esakii* Sasaji, 1968**
http://species-id.net/wiki/Aspidimerus_esakii
Figs 15–17, 43–47, 85

Aspidimerus esakii Sasaji, 1968: 16; 1986: 40; Pang and Mao 1979: 54; Pang 1998: 185; Yu 1995: 139; 2011: 166; Kovář 2007: 575; Ren et al. 2009: 106.

Diagnosis. This species is close to *A. chapaensis* in general appearance, but can be separated from it by the black elytra with four yellow spots (Fig. 15), and the antennae with 8 antennomeres. In *A. chapaensis*, elytra black with four red spots and the antennae with 9 antennomeres. The spermatheca is also diagnostic according to the illustrations given by Sasaji (1968) and Hoàng (1982).

Description. TL: 3.70mm, TW: 2.90mm, TH: 1.75mm, TL/TW: 1.28; PL/PW: 0.53; EL/EW: 1.00.

Body oblong oval, dorsum moderately convex and densely pubescent (Figs 15–17). Head yellowish brown, clypeus reddish brown, eyes black (Fig. 17). Pronotum black except anterior corners yellowish brown. Scutellum and elytra black. Each elytron with two yellowish brown spots (Figs 15–16). Underside black, except legs and abdomen reddish brown.

Head small, 0.45 times elytral width (HW/EW=1: 2.23). Punctures on frons small, separated by 0.5–1.0 times their diameter, with dense golden pubescence. Eyes large and oval, rather finely faceted, the widest interocular distance 0.50 times head width. Pronotum 0.69 times elytral width (PW/EW=1: 1.45), punctures on pronotum and scutellum fine, close, separated by 0.5–1.0 times their diameter, with thick, golden pubescence. Elytra finely punctate, with short yellow white pubescence. Surface of prosternum coarse, with sparse, long and yellowish pubescence. Punctures on metaventrite moderately large, separated by 0.5–1.0 times their diameter, with dense yellowish pubescence.

Male genitalia: Penis relatively long, slender and strongly curved, apex of penis with membranous appendage, penis capsule with a short indistinct outer process and a long inner one (Figs 43–45). Penis guide slender, gradually tapering to apex forming a pointed tip in lateral view (Fig. 47). In ventral view, penis guide broad, widest at basal 1/3 with truncate apex (Fig. 46). Parameres slender, sparsely setose at apex, equal in length to the penis guide (Fig. 47).

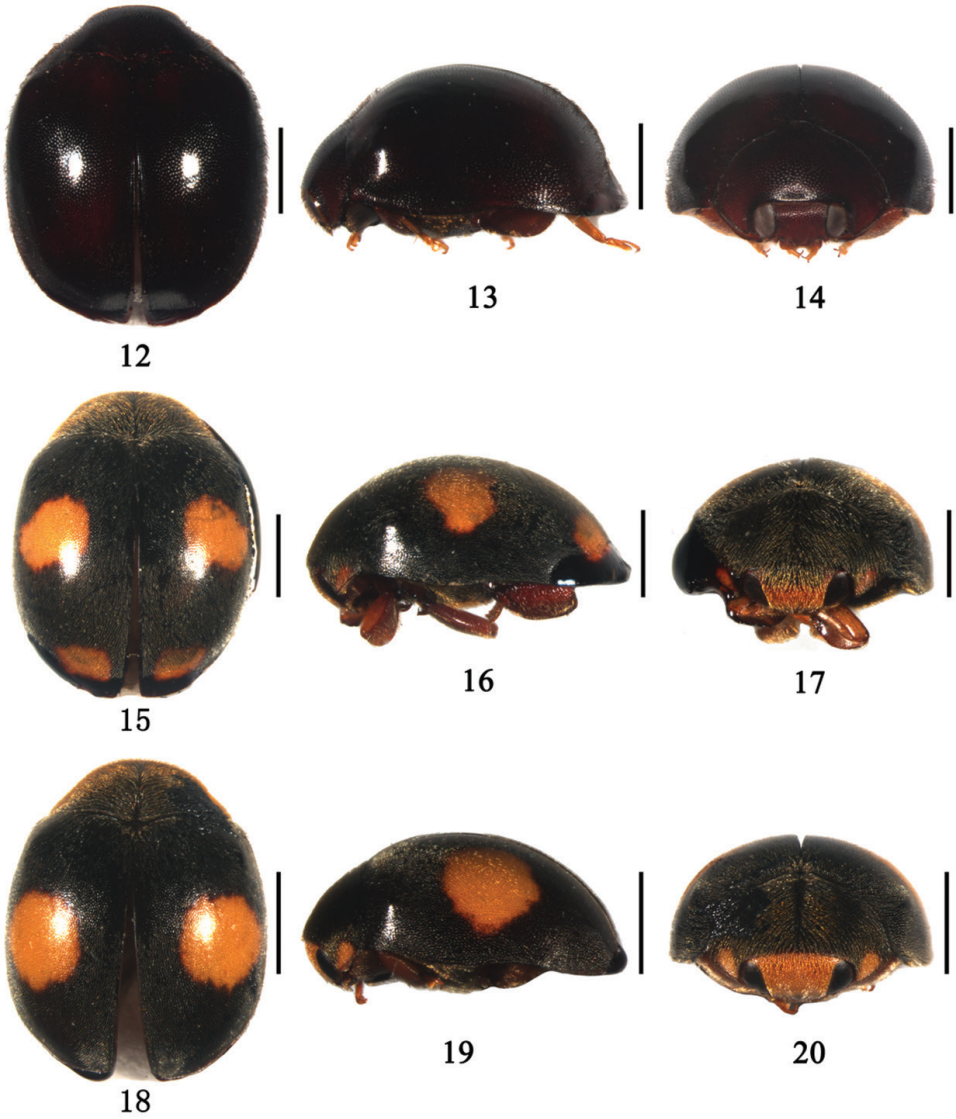
Specimens examined. China, Hainan: 1♂, Bawangling Natural Reserve, [19°05.49'N, 109°06.38'E], ca 260m,5.v.2005, Wang XM leg (SCAU).

Distribution. China (Hainan, Guangxi, Taiwan).

Aspidimerus menglensis **Huo & Ren, sp. n.**
http://zoobank.org/6F3968D5-DEE2-40C2-84FD-8D4A0D56D175
http://species-id.net/wiki/Aspidimerus_menglensis
Figs 18–20, 48–52, 85

Diagnosis. This species is similar to *A. birmanicus* (Gorham) in general appearance, but can be identified by the characters as follows: penis guide moderately broad, symmetrical, almost parallel-sided with arcuate apex in ventral view, distinctly shorter than parameres (Fig. 50), while in *A. birmanicus* (Gorham) penis guide narrow, slightly expanded in the middle and narrower towards the apex which is truncate.

It is also similar to *A. guangxiensis* in color pattern (Figs 18, 24), but can be distinguished from the latter by its larger size and male genitalia.



Figures 12–20. 12–14 *A. nigritus* (Pang & Mao), **12** dorsal view **13** lateral view **14** frontal view **15–17** *A. esakii* Sasaji, **15** dorsal view **16** lateral view **17** frontal view **18–20** *A. menglensis* Huo & Ren, sp. n. **18** dorsal view **19** lateral view **20** frontal view. Scale bars: 1.0mm.

Description. TL: 3.50–3.90mm, TW: 2.65–3.15mm, TH: 1.50–1.75mm, TL/TW: 1.24–1.32; PL/PW: 0.51–0.55; EL/EW: 1.02–1.13.

Body oval, dorsum moderately convex and pubescent (Figs 18–20). Head yellow with the base brown in male and black in female. Clypeus reddish brown. Eyes black. Pronotum black except anterior corner yellow (Fig. 20). Scutellum black. Elytra black with two round yellow spots (Fig. 18). Underside black, except mesoventrite and legs brown.

Figures 21–29. 21–23 *A. guangxiensis* Yu, **21** dorsal view **22** lateral view **23** frontal view **24–26** *A. matsumurai* Sasaji, **24** dorsal view **25** lateral view **26** frontal view **27–29** *A. kabakovi* Hoàng **27** dorsal view **28** lateral view **29** frontal view. Scale bars: 1.0mm.

Head small, 0.47 times elytral width (HW/EW=1: 2.12). Punctures on frons fine, separated by 0.2–0.5 times their diameter, with thick, golden pubescence. Eyes large and almost oval, rather finely faceted, the widest interocular distance 0.36 times head width. Pronotum 0.72 times elytral width (PW/EW=1: 1.39), closely covered with small punctures and golden pubescence, denser than those on head, punctures separated by 0.5–1.0 times their diameter. Punctures on elytra very fine and close,

separated by 0.5–1.5 times their diameter, with short silver white pubescence. Prosternum with sparse, coarse punctation and long pubescence. Mesoventrite small, with inconspicuous punctures and sparse pubescence. Metaventrite finely punctate, separated by 0.2–1.0 times their diameter, with pubescence dense, short and silver white.

Male genitalia: Penis long, strongly curved. Penis capsule with a short outer process and a long inner one (Fig. 48). Apex of penis with membranous appendage (Fig. 49). Penis guide slender in lateral view (Fig. 51). In ventral view, penis guide symmetrical, almost parallel-sided with arcuate apex (Fig. 50); Parameres slender, longer than penis guide, with dense long setation at its apex and inner side (Fig. 50).

Female genitalia: Tenth tergite fairly broad, 0.25 times as long as wide, with moderately long setae. Coxites subtriangular, each with a few long terminal setae (Fig. 52).

Types. Holotype: 1♂, China, Yunnan: Mengla, Xishuangbanna, [21°26.59'N, 101°38.01'E], ca 1160 m, 29.iv.2008, Wang XM leg. (SCAU). **Paratypes** (3): Yunnan: 1♂, Nanping, Mengla, [21°39.55'N, 101°22.52'E], ca 750m, 10.v.2009, Ren SX leg. (SCAU); 1♀, Mengla, Xishuangbanna, [21°26.59'N, 101°38.01'E], ca 1160m, 29.iv.2008, Wang XM leg. (SCAU); 1♂, Longmen, Mengla, [21°30.17'N, 101°31.44'E], ca 760m, 1.v.2008, Wang XM leg. (SCAU).

Distribution. China (Yunnan).

Etymology. The specific epithet refers to the type locality, Mengla, Yunnan.

Aspidimerus guangxiensis Yu, 2004

http://species-id.net/wiki/Aspidimerus_guangxiensis
Figs 21–23, 53–55, 85

Aspidimerus guangxiensis Yu, 2004: 329; Ren et al. 2009: 106.

Diagnosis. This species is similar to *A. matsumurai* Sasaji in elytra with two spots (Figs 21, 24), but can be distinguished from the latter by its smaller size and unique male genitalia: penis short, apical 1/2 length with membranous appendage (Fig. 53), penis guide extremely broad, widest at base, gradually narrowing to the apex, apex with a lateral, hook-like process in ventral view (Fig. 54). In *A. matsumurai*, penis short, apical 2/5 length with less membranous appendage (Fig. 56), penis guide broad in ventral view, nearly parallel-sided at basal 6/7, then strongly and asymmetrically convergent to a pointed tip (Fig. 58).

Description. TL: 2.75–2.80mm, TW: 2.25–2.30mm, TH: 1.55–1.65mm, TL/TW: 1.25–1.30; PL/PW: 0.50–0.55; EL/EW: 0.91–1.11.

Body small, oval, moderately convex, dorsal surface pubescent (Figs 21–23). Head yellow or reddish brown with eyes black (Fig. 23). Pronotum black, with basal margin reddish brown and anterior corners yellowish brown. Scutellum and elytra black. Each elytron with one yellowish brown spot, rounded, situated at the middle of elytron (Fig. 21). Underside dark brown, except legs and abdomen reddish brown.

Head small, 0.44 times elytral width (HW/EW=1: 2.25). Punctures on frons fine, separated by 1.0–2.0 times their diameter, with short silver white setae. Eyes small, broadly oval, widest interocular distance 0.55 times head width (Fig. 20). Pronotum 0.67 times elytral width (PW/EW=1: 1.50). Pronotal punctures fine, separated by 1.0–3.0 times their diameter. Scutellum triangular. Punctures on elytra slightly larger than those on pronotum, separated by 1.0–2.0 times their diameter. Prosternum coarse, with sparse punctation and long pubescence. Mesoventrite small, with a few setae. Metaventrite densely pubescent with punctures large and closely spaced, separated by 0.5–1.0 times their diameter.

Male genitalia: Penis short and stout. Penis capsule with a distinctly outer process and a long inner one (Fig. 53). Penis guide widest at base and abruptly constricted forming a pointed apex in lateral view (Fig. 55). In ventral view, penis guide flat and asymmetrical, widest at base, gradually narrowing to the apex, apex with a lateral, hook-like process (Fig. 54). Parameres slender, sparsely setose at apex, shorter than penis guide (Fig. 55).

Female genitalia: Unknown.

Specimens examined. China, Guangxi: 1♂, Shiwandashan Natural Reserve, Shangsi, [21°54.36'N, 107°54.28'E], ca 300m, 27.vii.2005, Zhang CW leg(SCAU); 1♂, Fulong, Fangchenggang, [22°51.03'N, 107°55.43'E], ca 230m, 28.vii.2005, Wang XM leg (SCAU).

Distribution. China (Guangxi).

Aspidimerus matsumurai Sasaji, 1968

http://species-id.net/wiki/Aspidimerus_matsumurai
Figs 24–26, 56–60, 85

Aspidimerus matsumurai Sasaji, 1968: 17; Pang and Mao 1979: 53; Hoàng 1982: 162; Cao and Xiao 1984: 98; Cao et al. 1992: 131; Pang 1998: 185; Kovář 2007: 575; Ren et al. 2009: 108; Yu 2011: 167.

Diagnosis. This species is close to *A. guangxiensis* and *A. birmanicus* (Gorham) in dorsal coloration, but can be identified by the following characters: Penis stout and short. Penis capsule with a small inner process (Fig. 56). In ventral view, penis guide extremely broad, nearly parallel-sided at basal 6/7, then strongly and asymmetrically convergent to a pointed tip (Fig. 58). In *A. guangxiensis*, penis guide widest at base, gradually narrowing to the apex, apex with a lateral hook-like process in ventral view (Fig. 54). In *A. birmanicus*, penis relatively long, penis capsule with a long inner process, penis guide distinctly narrower than that of *A. matsumurai* in ventral view.

A. matsumurai is also similar to *A. laokayensis* in male genitalia, but can be distinguished from the latter by its color pattern and detailed structure of genitalia.

Description. TL: 3.75–4.60mm, TW: 3.00–3.50mm, TH: 1.65–2.00mm, TL/TW: 1.25–1.31; PL/PW: 0.50–0.51; EL/EW: 0.97–1.03.

Body oblong oval, moderately convex and pubescent (Figs 24–26). Head yellow with clypeus dark brown and eyes black (Fig. 26). Pronotum black except anterolateral corners and anterior margin yellowish brown (Fig. 26). Scutellum black. Elytra black with two round red (sometimes yellowish brown) spots (Fig. 24). Underside black, except legs and abdomen reddish brown.

Head small, 0.42 times elytral width (HW/EW=1: 2.40). Punctures on frons close, separated by 0.3–0.5 times their diameter, with thin, yellow white pubescence. Eyes large and broadly oval, rather finely faceted, widest interocular distance 0.60 times head width, posterior of the eye with silver setae. Pronotum 0.73 times elytral width (PW/EW=1: 1.36). Pronotal punctures similar to those on head, separated by 0.5–1.5 times their diameter, with thick silver white pubescence. Punctures on elytra slightly larger than those on pronotum, separated by 0.5–1.0 times their diameter. Prosternum coarsely punctate, with pubescence sparse, long and yellowish. Mesoventrite indistinctly punctate, with several hairs. Punctures on metaventrite fine, separated by 0.2–0.5 times their diameter, with long setae.

Male genitalia: Penis stout and short, curved at basal 1/3, gradually narrowing to the apex (Fig. 56). Apical 2/5 length of penis with membranous appendage. Penis capsule with a large outer process and a small inner one (Figs 56–57). Penis guide stout, spoon-shaped in lateral view (Fig. 59). In ventral view, penis guide very broad, nearly parallel-sided, slightly divergent apically, apical part asymmetrical, suddenly and strongly convergent to a blunted tip (Fig. 58). Parameres slender, sparsely setose at apex, slightly shorter than penis guide (Fig. 59).

Female genitalia: Tenth tergite broad, arc-shaped with terminal setae. Coxites broad, 0.4 times as long as wide, each with moderately long terminal setae (Fig. 60); spermatheca absent.

Specimens examined. China, Yunnan: 1 male, Nanping, Mengla, [21°39.55'N, 101°22.52'E], ca 740m, 16.v.2008, Ren SX leg (SCAU); Hainan: 1♂1♀, Diaoluoshan National Forest Park, [18°47.30'N, 109°52.58'E], ca 280m, 8.v.2005, Wang XM leg (SCAU).

Distribution. China (Yunnan, Hainan, Taiwan); Vietnam.

Aspidimerus kabakovi **Hoàng, 1982**

http://species-id.net/wiki/Aspidimerus_kabakovi
Figs 27–29, 61–64, 86

Aspidimerus kabakovi Hoàng, 1982: 167.

Diagnosis. This species can be easily distinguished by the following characters: elytra brown with 5 subrounded black spots disposed as Fig. 27. Apical 1/3 length of penis is very characteristic (Fig. 61). Penis guide broad, basal 2/3 length nearly parallel-sided, apical 1/3 strongly convergent with rounded apex (Fig. 62).

Description. TL: 2.85–3.50mm, TW: 2.40–2.85mm, TH: 1.25–1.75mm, TL/TW: 1.19–1.23; PL/PW: 0.52; EL/EW: 0.94–0.96.

Body subrounded, dorsum moderately convex and pubescent (Figs 27–29). Head yellowish brown with clypeus reddish brown, eyes black or silver white. Pronotum black except anterior margin and anterior corners brown (Fig. 29). Scutellum black. Elytra brown with 5 subrounded black spots arranged as follows: 1 on the middle of suture and 2 on each elytron, the front larger, confluent with the border (Figs 27–28). Underside reddish brown, except prosternum, mesoventrite and metaventrite dark brown.

Head small, 0.42 times elytral width (HW/EW=1: 2.40). Punctures on frons small, separated by 0.5–1.0 times their diameter. Eyes large, widest interocular distance 0.60 times head width. Dorsal surface finely punctate, with dense, silver white pubescence. Pronotum 0.69 times elytral width (PW/EW=1: 1.45). Underside finely punctate, with pubescence dense, short and silver white.

Male genitalia: Penis stout with apical 1/3 length very characteristic as shown in Fig. 61. Penis capsule with distinct outer and inner processes (Fig. 61). Penis guide stout and slightly curved in lateral view (Fig. 63). In ventral view, penis guide broad, basal 2/3 length nearly parallel-sided, apical 1/3 strongly convergent with rounded apex (Fig. 62). Parameres slender, as long as the penis guide, sparsely setose at apex (Fig. 62).

Female genitalia: tenth tergite fairly broad, 0.15 times as long as wide, setaceous at apex, coxites subtriangular with a few long terminal setae (Fig. 64); spermatheca absent.

Specimens examined. China, Guangdong: 1♂, Nankunshan Natural Reserve, Huizhou, [23°37.54'N, 113°52.56'E], ca 490m, 5.viii.1986, Pang XF leg (SCAU); Guangxi: 1♀, Shiwandashan Natural Reserve, Shangsi, [21°54.25'N, 107°54.33'E], ca 380m, 9.ix.2004, Lv XB leg (SCAU); 1♂, Maoershan Natural Reserve, 18.x.2004, [25°51.50'N, 110°25.10'E], ca 1350m,Wang XM leg (SCAU); 1♂, Fulong, Fangchenggang, [22°05.19'N, 107°59.28'E], ca 220m, 29.vii.2005, Qin ZQ leg (SCAU); Yunnan: 1♀, Dajianshan, Pingbian, [22°54.14'N, 103°41.52'E], 2100m, 20.iv.2008, Wang XM leg (SCAU).

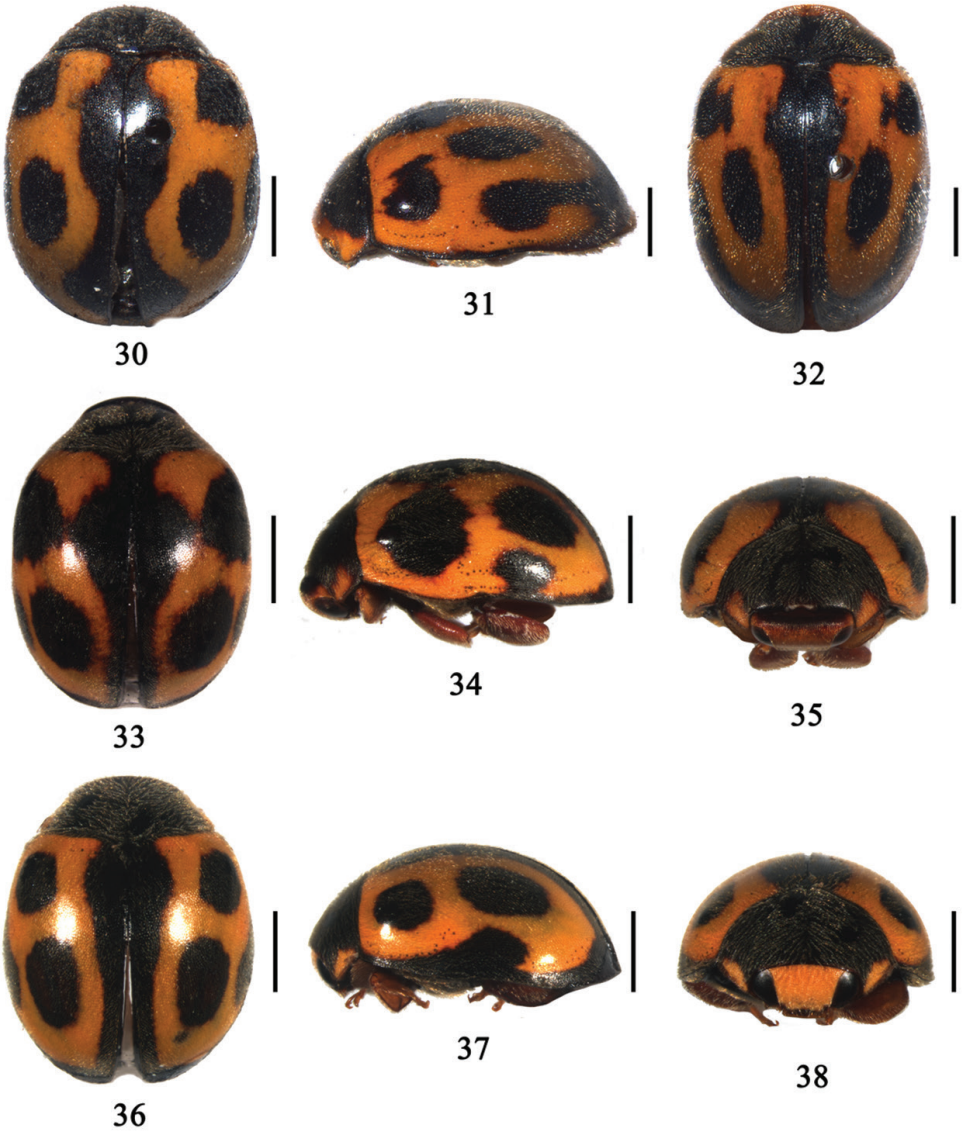
Distribution. China (Guangdong, Guangxi, Yunnan); Vietnam.

Aspidimerus decemmaculatus **Pang & Mao, 1979**

http://species-id.net/wiki/Aspidimerus_decemmaculatus
Figs 30, 65–68, 86

Aspidimerus decemmaculatus Pang & Mao, 1979: 56; Cao and Xiao 1984: 98; Cao et al. 1992: 134; Pang 1998: 186; Kovář 2007: 575; Ren et al. 2009: 106.

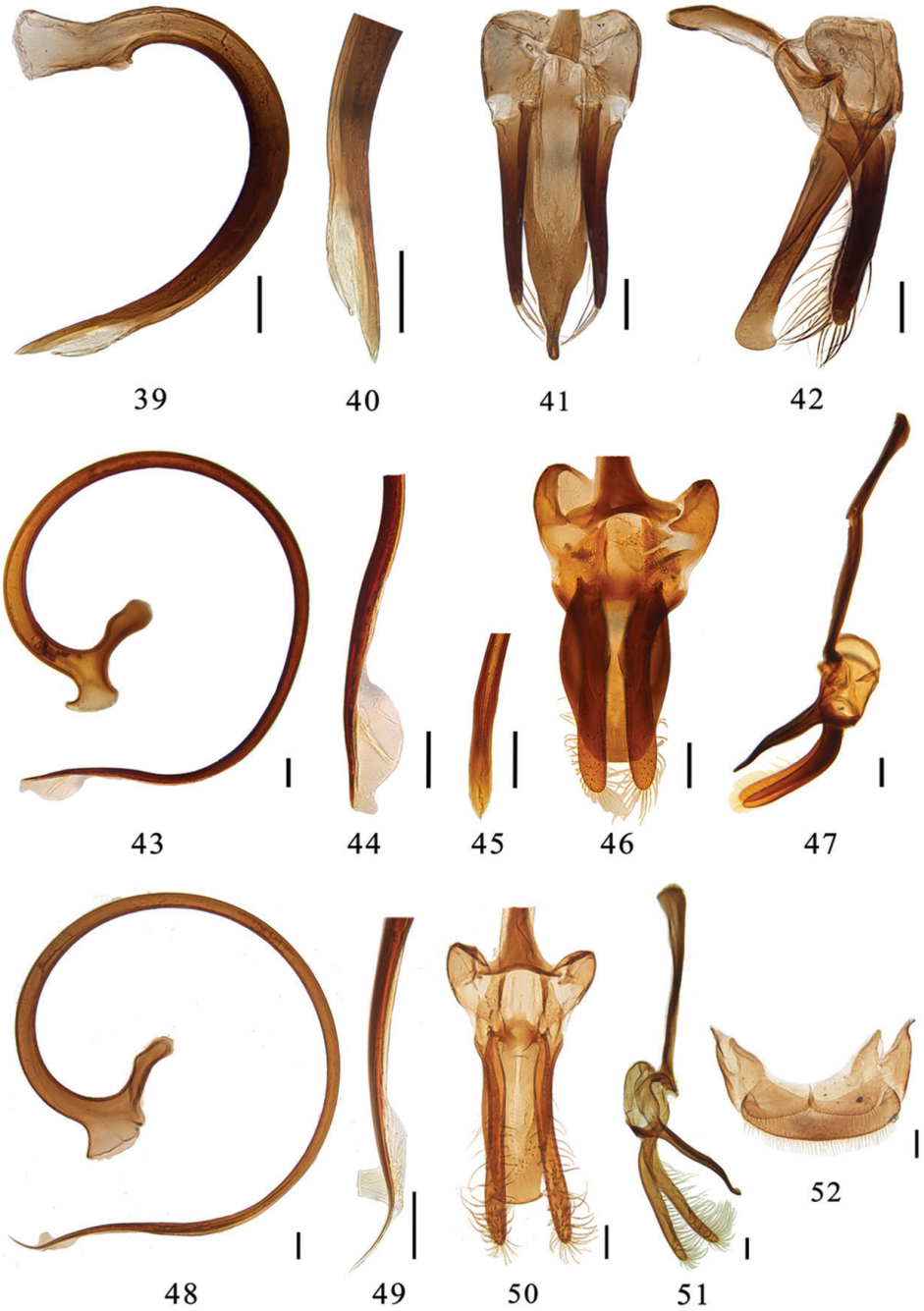
Diagnosis. This species can be easily distinguished from other *Aspidimerus* by the following characters: elytra with 8 black spots and a black sutural stripe which expanded at near basal and apical part (Fig. 30). Penis capsule extremely expanded (Fig. 65). Penis guide subtriangular, widest at base with rounded apex in ventral view (Fig. 67).



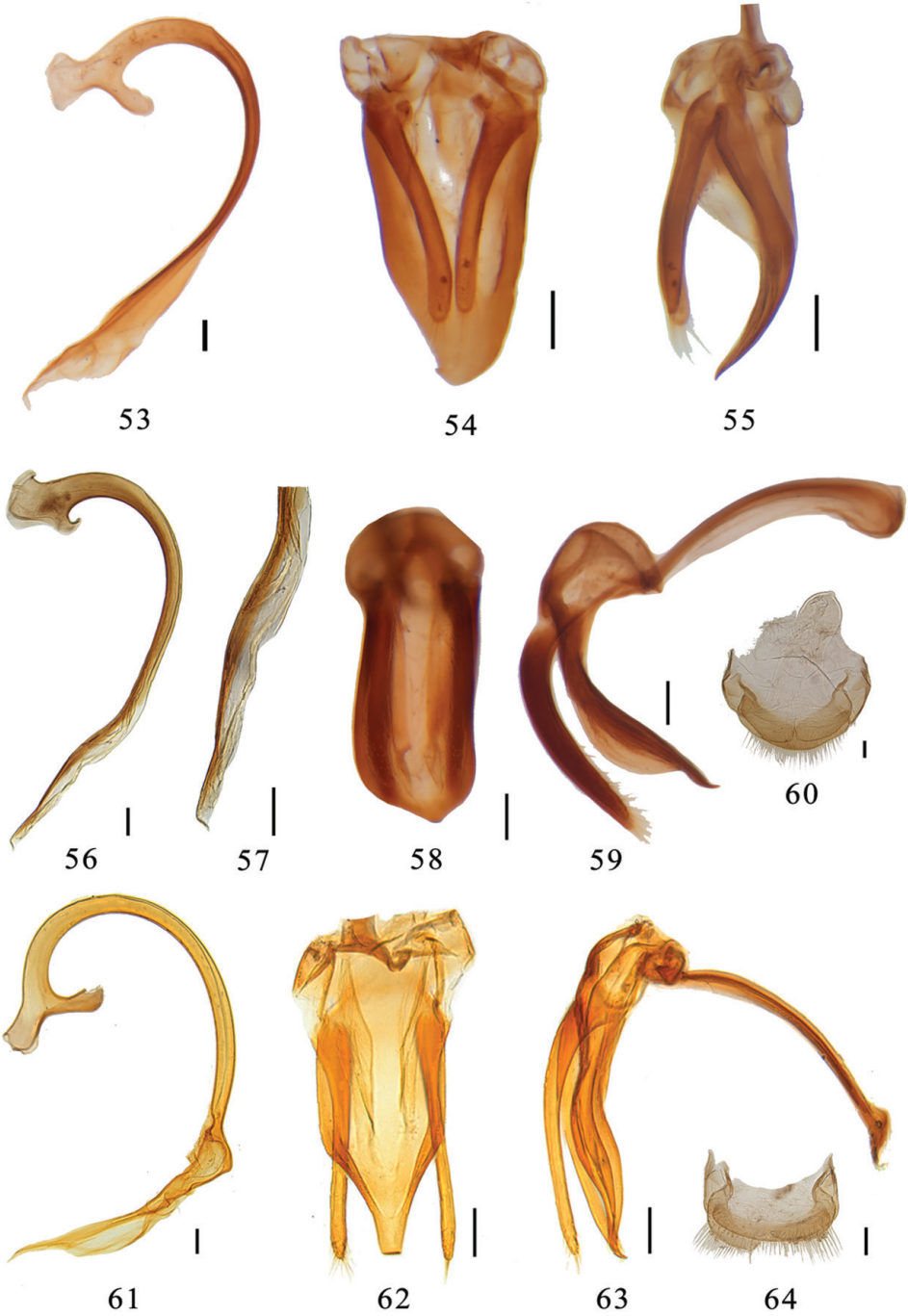
Figures 30–38. 30 *A. decemmaculatus* Pang & Mao, dorsal view; **31–32** *A. mouhoti* Crotch, **31** lateral view **32** dorsal view **33–35** *A. zhenkangicus* Huo & Ren, sp. n. **33** dorsal view **34** lateral view **35** frontal view **36–38** *A. ruficrus* Gorham, **36** dorsal view **37** lateral view **38** frontal view. Scale bars: 1.0mm.

Description. TL: 4.10mm, TW: 3.30mm, TH: 1.46mm, TL/TW: 1.24; PL/PW: 0.39; EL/EW: 1.09.

Body large, oblong oval, dorsum moderately convex and pubescent (Fig. 30). Head yellowish brown with eyes black. Pronotum black, with anterior corners yellowish brown. Scutellum black. Elytra yellowish brown. Elytral margins black. Each



Figures 39–52. 39–42 *A. nigritus* (Pang & Mao), male genitalia: **39** penis **40** apex of penis **41** tegmen, ventral view **42** tegmen, lateral view **43–47** *A. esakii* Sasaji, male genitalia: **43** penis **44** apex of penis **45** apex of penis, ventral view **46** tegmen, ventral view **47** tegmen, lateral view **48–52** *A. menglensis* Huo & Ren, sp. n. **48–51** male genitalia: **48** penis **49** apex of penis **50** tegmen, ventral view **51** tegmen, lateral view **52** female genitalia: ovipositor. Scale bars: 0.1mm.



Figures 53–64. 53–55 *A. guangxiensis* Yu, male genitalia: **53** penis **54** tegmen, ventral view **55** tegmen, lateral view **56–60** *A. matsumurai* Sasaji **56–59** male genitalia: **56** penis **57** apex of penis **58** tegmen, ventral view **59** tegmen, lateral view **60** female genitalia: ovipositor **61–64** *A. kabakovi* Hoàng **61–63** male genitalia **61** penis **62** tegmen, ventral view **63** tegmen, lateral view **64** female genitalia: ovipositor. Scale bars: 0.1mm.

elytron with 4 black spots besides a black sutural stripe which expanded at near basal and apical part. Elytral spots arranged as follows: spot 1 triangle, situated on humeral callus, spot 2 subrounded, posterior to the transverse middle line, nearer the suture, spot 3 small, oblong, and confluent with the border, spot 4 small, prior apex, confluent with the border (Fig. 30). Underside black, except legs and abdomen reddish brown.

Head small, 0.38 times elytral width (HW/EW=1: 2.64). Punctures on frons fine, separated by 0.5–1.0 times their diameter, with thin, yellow white pubescence. Eyes large and almost oval, finely faceted, the widest interocular distance 0.56 times head width. Pronotum 0.60 times elytral width (PW/EW=1: 1.67). Punctures on pronotum and elytra close, separated by 0.5–1.0 times their diameter, with thick, yellowish pubescence. Underside coarsely punctate, with sparse yellowish pubescence.

Male genitalia: Penis short, penis capsule with an extremely expanded outer process and a short inner process (Fig. 65). Apex of penis with membranous appendage (Fig. 66). In ventral view, penis guide subtriangular, widest at base with a rounded apex (Fig. 67). Penis guide slender and waved, gradually tapering to apex in lateral view, parameres slender, sparsely setose at apex, slightly shorter than penis guide (Fig. 68).

Female genitalia: Unknown.

Specimens examined. Holotype: 1♂, China, Yunnan: Mengzhe, Xishuangbanna, [22°01.42'N, 100°17.41'E], ca 1350m, 26.vi.1958, Wang SY leg. (IOZ).

Distribution. China (Yunnan).

Aspidimerus mouhoti **Crotch, 1874**

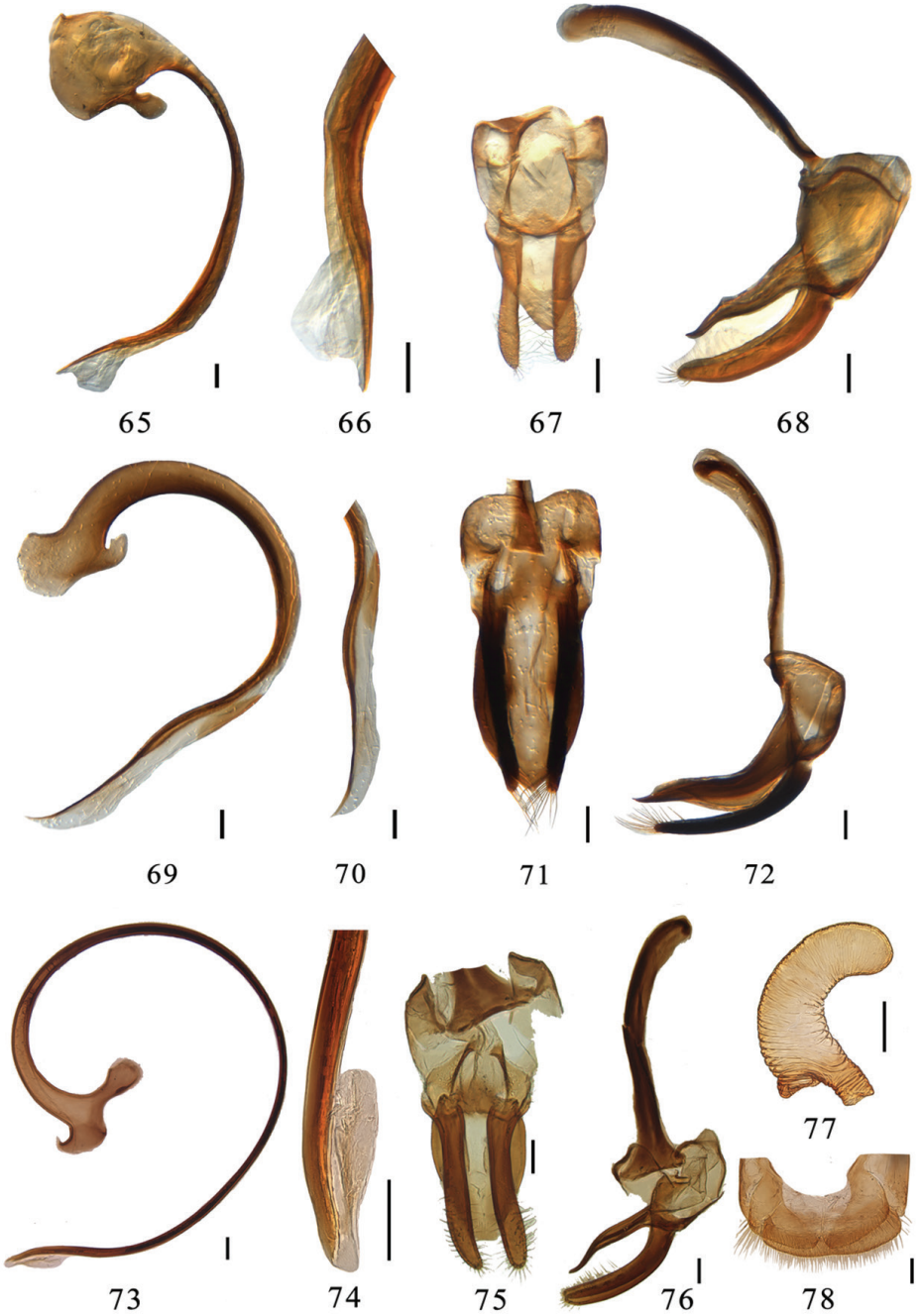
http://species-id.net/wiki/Aspidimerus_mouhoti
Figs 31–32, 69–72, 86

Aspidimerus mouhoti Crotch, 1874: 202; Korschefsky 1931: 172.
Aspidimerus sexmaculatus Pang & Mao, 1979: 55; Cao and Xiao 1984: 98; Cao et al. 1992: 133; Pang 1998: 186; Kovář 2007: 73, 575; Ren et al. 2009: 110. Synonymized by Kovář 2007: 73.

Diagnosis. This species is similar to *A. ruficrus* in general appearance, but can be distinguished by the stout, strongly curved penis guide in lateral view and symmetrical with obtuse apex in ventral view (Figs 71–72). In *A. ruficrus*, penis guide slender, slightly straight in lateral view and vase-shaped with truncate apex in ventral view (Figs 81–82). The shape of penis is also diagnostic (Fig. 69).

Description. TL: 4.80mm, TW: 3.60mm, TH: 1.58mm, TL/TW: 1.33; PL/PW: 0.33; EL/EW: 1.14.

Body relatively large, oval, dorsum convex and pubescent (Fig. 32). Head yellowish brown in male and reddish brown in female. Eyes black. Clypeus, mouthparts and antennae reddish brown. Pronotum black with anterior corner yellowish brown (Fig. 31). Scutellum black. Elytra yellowish brown with 3 black spots on each elytron, spot 1 subrounded, situated on humeral callus, spot 2 long oval, largest, situated on middle



Figures 65–78. 65–68 *A. decemmaculatus* Pang & Mao, male genitalia: **65** penis **66** apex of penis **67** tegmen, ventral view **68** tegmen, lateral view **69–72** *A. mouhoti* Crotch, male genitalia: **69** penis **70** apex of penis **71** tegmen, ventral view **72** tegmen, lateral view **73–78** *A. zhenkangicus* Huo & Ren, sp. n. **73–76** male genitalia: **73** penis **74** apex of penis **75** tegmen, ventral view **76** tegmen, lateral view **77–78** female genitalia: **77** spermatheca **78** ovipositor. Scale bars: 0.1mm.

of elytra, spot 3 smaller, oblong, and extending to the apex confluent with the border (Figs 31–32). Lateral margins black. Underside reddish brown except prosternum, mesoventrite and metaventrite black.

Head transverse and ventrally flattened, 0.36 times elytral width (HW/EW=1: 2.77). Punctures on frons moderately large, separated by 0.5–1.0 times their diameter, with short sparsely distributed setae. Eyes moderately large and finely faceted, widest interocular distance 0.62 times head width. Pronotum 0.70 times elytral width (PW/EW=1: 1.43), closely covered with fine punctures associated with long dense pubescence, punctures smaller than those on head, separated by 0.5–1.5 times their diameter. Punctures on elytra very fine and close, similar to those on pronotum, with dense silver white pubescence. Prosternum coarse, with sparse long yellowish pubescence. Punctures on metaventrite moderately large, separated by 0.5–1.0 times their diameter, with dense yellowish pubescence.

Male genitalia: Penis short and stout, strongly curved at basal half, apical half with membranous appendage (Figs 69–70). Penis capsule with a large outer process and a small, unciform inner process (Fig. 69). Penis guide stout and strongly curved in lateral view (Fig. 72). In ventral view, penis guide symmetrical, widest at middle and converging gradually to a blunted tip (Fig. 71). Parameres slender, equal in length to penis guide, sparsely setose at apex (Fig. 72)

Female genitalia: Unknown.

Specimens examined. 1♂, China, Yunnan: Menghun, Xishuangbanna, [21°50.56'N, 100°23.02'E], ca 1200m, 15.vi.1958, Pu FJ leg. (Holotype of *Aspidimerus sexmaculatus* Pang & Mao, IOZ).

Distribution. China (Yunnan); Laos (Mouhot).

Aspidimerus zhenkangicus Huo & Ren, sp. n.

http://zoobank.org/F3B523AB-4599-4496-BD86-D437E3C60D1E
http://species-id.net/wiki/Aspidimerus_zhenkangicus
Figs 33–35, 73–78, 86

Diagnosis. This species closely resembles *A. ruficrus* in elytral color pattern (Figs 33, 36), but male genitalia are quite different (Figs 73–76; 79–82). It is also similar to *A. esakii* in male genitalia, but can be distinguished from the latter by the elytra yellow with 7 black spots (Fig. 33), apex of penis with relatively small membranous appendage (Fig. 73), different shape of penis capsule (Figs 43, 73) and more narrowly truncate apex of penis guide in ventral view (Figs 46, 75). The spermatheca (Fig. 77) is also different from that of *A. esakii* given by Sasaji (1968).

Description. TL: 4.50–4.75mm, TW: 3.40–3.60mm, TH: 2.00–2.25mm, TL/TW: 1.32; PL/PW: 0.54–0.56; EL/EW: 1.04–1.06.

Body medium size and oval, dorsum moderately convex and pubescent (Fig. 33–35). Head dark yellow with basal margin and clypeus reddish brown, eyes black. Pronotum black, except anterior corners dark yellow (Fig. 35). Scutellum black. Elytra yellowish brown with black sutural stripe distinctly expanded near basal half (Fig. 33).

Elytral margins black. Each elytron with 3 black spots arranged as Fig. 34. Underside reddish brown, except legs dark yellow.

Head small, 0.44 times elytral width (HW/EW=1: 2.27). Surface of head with fine punctures, separated by 0.3–1.0 times their diameter, with thick, yellowish pubescence. Eyes large and almost oval, rather finely faceted, the widest interocular distance 0.50 times head width. Pronotum 0.71 times elytral width (PW/EW=1: 1.42). Punctation on pronotum sparser than on head, separated by 1.0–1.5 times their diameter, with thick, yellowish pubescence. Surface of elytra densely pubescent and sparsely punctate, punctures separated by 0.5–2.0 times their diameter. Underside finely punctate, with pubescence dense, moderately long and yellowish.

Male genitalia: Penis relatively long, slender, curved almost in a circle. Penis capsule with a short outer process and a long inner one, apex of penis with relatively small membranous appendage (Figs 73–74). Penis guide slender, gradually tapering to apex in lateral view (Fig. 76). In ventral view, penis guide short oval, widest at base with truncate apex (Fig. 75). Parameres slender, densely setose along almost half of their length, longer than penis guide (Fig. 76).

Female genitalia: Tenth tergite broad with terminal setae. Coxites subtriangular with moderately long terminal setae (Fig. 78). Spermatheca vermiform with wide nodulus and long ramus (Fig. 77).

Types. Holotype: 1♂, China, Yunnan: Mengdui, Zhenkang, [23°53.47'N, 98°53.33'E], ca 1400m, 18.vi.2008, Wang XM leg. (SCAU). **Paratypes** (5): Yunnan: 1♂, Longmen, Mengla, [21°15.12'N, 101°38.52'E], ca 1030m, 9.v.2009, Ren SX leg. (SCAU); 1♂, Yaoqu, Mengla, [21°41.22'N, 101°34.07'E], ca 700m, 7.v.2009, Ren SX leg. (SCAU); 1♂1♀, Dadugang, Jinghong, [22°21.39'N, 100°54.28'E], ca 1050m, 5.v.2009, Wang XM leg. (SCAU); 1♀, Xiaomengyang, Xishuangbanna, [22°04.50'N, 100°54.18'E], ca 790m, 27.iv.2008, Wang XM leg. (SCAU).

Distribution. China (Yunnan).

Etymology. The specific epithet refers to the location of the holotype, Zhenkang, Yunnan.

Aspidimerus ruficrus Gorham, 1895

http://species-id.net/wiki/Aspidimerus_ruficrus
Figs 36–38, 79–84, 86

Aspidimerus ruficrus Gorham, 1895: 690; Korschefsky 1931: 173; Kapur 1948: 83; Pang and Mao 1979: 55; Cao and Xiao 1984: 98; Cao et al. 1992: 134; Pang 1998: 186; Kovář 2007: 575; Ren et al. 2009: 108; Poorani 2002: 343.
Cryptogonus blandus Mader, 1954: 130; Liu 1963: 84. **syn. n.**
Aspidimerus blandus (Mader, 1954): Kovář 2007: 73. Combined by Kovář 2007: 73.

Diagnosis. This species is similar to *A. mouhoti* in general appearance, but can be distinguished by the penis guide slender and slightly straight in lateral view and vase-

Figures 79–84. *A. ruficrus* Gorham, **79–82** male genitalia: **79** penis **80** apex of penis **81** tegmen, ventral view **82** tegmen, lateral view **83–84** female genitalia: **83** spermatheca **84** ovipositor. Scale bars: 0.1mm.

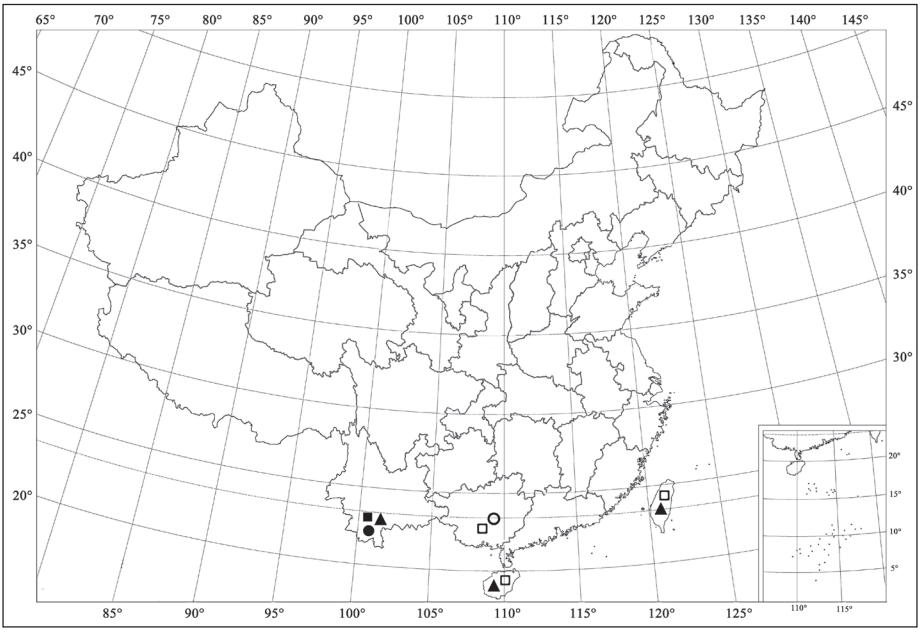
shaped with truncate apex in ventral view (Figs 81–82). The shape of penis is also diagnostic (Fig. 79).

Description. TL: 3.75–4.00mm, TW: 3.00–3.25mm, TH: 1.55–1.65mm, TL/TW: 1.23–1.25; PL/PW: 0.54–0.56; EL/EW: 0.98–1.00.

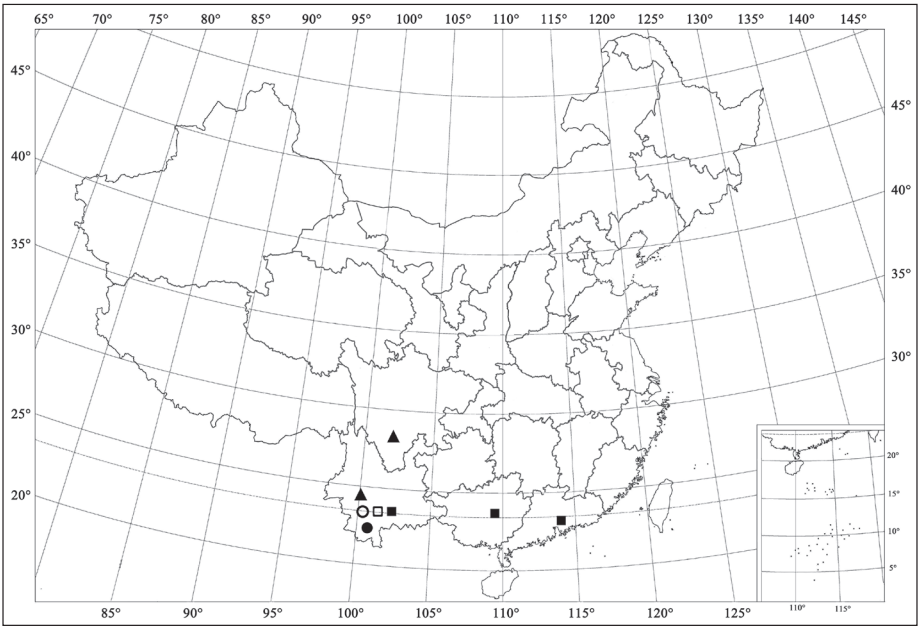
Body oblong oval, dorsum moderately convex and pubescent (Figs 36–38). Head deep yellow in male and black in female. Eyes black or silver. Pronotum black with anterior corners deep yellow (Fig. 38). Scutellum black. Elytra deep yellow with a black border along all the margins and three black spots (Figs 36–37). Spot 1 rounded, situated on humeral callus. Spot 2 subrounded, largest, posterior to the transverse middle line, nearer the suture. Spot 3 small, oblong, and confluent with the lateral margin. Underside black, except legs and abdomen reddish brown.

Head small and transverse, 0.43 times elytral width (HW/EW=1: 2.31). Punctures on frons finer, separated by 0.5–1.0 times their diameter, with thin, yellow white pubescence. Eyes moderately large and rather finely faceted, the widest interocular distance 0.31 times head width. Pronotum convex and transverse, 0.68 times elytral width (PW/EW=1: 1.46), covered with finely close punctures associated with dense yellowish pubescence. Punctures on elytra fine and close, smaller than those on pronotum, separated by 1.0–2.0 times their diameter, with dense silver white pubescence. Scutellum subtriangular. Punctures on prosternum coarse, with sparse long pubescence. Mesoventrite with yellow white pubescence. Metaventrite coarsely punctate, separated by 0.3–0.5 times their diameter, with pubescence sparse, moderately long and yellowish.

Male genitalia: Penis long, curved almost in a circle. Penis capsule with an expanded outer process and a small inner one (Fig. 79). Apex of penis with membranous appendage (Fig. 80). Penis guide slender and nearly straight in lateral view (Fig. 82). In ventral view, penis guide vase-shaped, widest at middle, with truncate apex (Fig. 81). Parameres slender, equal in length to penis guide, sparsely setose at apex (Fig. 82).



Figures 85. Distribution map. *Aspidimerus nigritus* (Pang & Mao) (■); *Aspidimerus esakii* Sasaji (□); *Aspidimerus menglensis* Huo & Ren, sp. n. (●); *Aspidimerus guangxiensis* Yu (○); *Aspidimerus matsumurai* Sasaji (▲).



Figures 86. Distribution map. *Aspidimerus kabakovi* Hoàng (■); *Aspidimerus decemmaculatus* Pang & Mao (□); *Aspidimerus mouhoti* Crotch (●); *Aspidimerus zhenkangicus* Huo & Ren, sp. n. (○); *Aspidimerus ruficrus* Gorham (▲).

Female genitalia: Tenth tergite moderately broad and coxites subtriangular, each with a few long terminal setae (Fig. 84). Spermatheca with a wide nodulus, a stout cornu and a short ramus (Fig. 83).

Specimens examined. China, **Yunnan**: 2♂1♀, Longmen, Mengla, [21°15.12'N, 101°38.52'E], ca 1030m, 9.v.2009, Ren SX leg (SCAU); 1♀, Longmen, Mengla, [21°30.17'N, 101°31.44'E], ca 760m, 1.v.2008, Wang XM leg (SCAU); 1♀, Mengdui, Zhenkang, [23°53.47'N, 98°53.33'E], 1400m, 18.v.2008, Wang XM leg (SCAU).

Distribution. China (Sichuan, Yunnan); Vietnam; Burma.

Remarks. Mader (1954) described the species *Cryptogonus blandus* based on 1 male and 3 female specimens which were collected from Yunnan, China. Liu (1963) recorded *C. blandus* Mader in his monography and mentioned that this species belongs to the genus *Aspidimerus* according to the character of its prosternal lines. Kovář (2007) transferred *C. blandus* to the genus *Aspidimerus* without further explanation. An examination of the specimens of *A. blandus* (Mader) collected from type locality show that the characters of the adult, including the male genitalia, were in perfect agreement with the descriptions and illustrations of *A. ruficrus* given by Kapur (1948). Therefore, we considered *A. blandus* (Mader, 1954) as a junior synonym of *A. ruficrus* Gorham, 1895.

Catalogue of *Aspidimerus* Mulsant, 1850

Aspidimerus Mulsant, 1850: 944. Type species: *Aspidimerus spencii* Mulsant, 1850.
Aspidimerus Mulsant: Gorham 1895: 690. Crotch 1874: 202; Weise 1885: 232; 1900: 426; Mader 1926: 16; Korschefsky 1931: 172; Kapur 1948: 81; Sasaji 1968: 15; Pang and Mao 1979: 53; Hoàng 1982: 161; Pang 1998: 185; Poorani 2002: 343; Yu and Li 2004: 329; Ren et al. 2009: 106.

Aspidimerus birmanicus (Gorham, 1895)
Cryptogonus birmanicus Gorham, 1895: 691.
Aspidimerus birmanicus (Gorham): Kapur 1948: 84; Poorani 2002: 343. Combined by Kapur 1948: 84.
Distribution. Burma; Thailand.

Aspidimerus chapaensis Hoàng, 1982
Aspidimerus chapaensis Hoàng, 1982: 166.
Distribution. Vietnam.

Aspidimerus decemmaculatus Pang & Mao, 1979
Aspidimerus decemmaculatus Pang & Mao, 1979: 56; Cao and Xiao 1984: 98; Cao et al. 1992: 134; Pang 1998: 186; Kovář 2007: 575; Ren et al. 2009: 106.
Distribution. China (Yunnan).

Aspidimerus esakii Sasaji, 1968
Aspidimerus esakii Sasaji, 1968: 16; Pang and Mao 1979: 54; Pang 1998: 185; Yu 1995: 139; 2011: 166; Kovář 2007: 575; Ren et al. 2009: 106.
Distribution. China (Hainan, Guangxi, Taiwan).

Aspidimerus guangxiensis Yu, 2004
Aspidimerus guangxiensis Yu, 2004: 329; Ren et al. 2009: 106.
Distribution. China (Guangxi).

Aspidimerus kabakovi Hoàng, 1982
Aspidimerus kabakovi Hoàng, 1982: 167.
Distribution. China (Guangdong, Guangxi, Yunnan); Vietnam.

Aspidimerus laokayensis Hoàng, 1982
Aspidimerus laokayensis Hoàng, 1982: 164.
Distribution. Vietnam.

Aspidimerus matsumurai Sasaji, 1968
Aspidimerus matsumurai Sasaji, 1968: 17; Pang and Mao 1979: 53; Hoàng 1982: 162; Cao and Xiao 1984: 98; Cao et al. 1992: 131; Pang 1998: 185; Kovář 2007: 575; Ren et al. 2009: 108; Yu 2011: 167.
Distribution. China (Yunnan, Hainan, Taiwan); Vietnam.

Aspidimerus menglensis Huo & Ren, sp. n.
Aspidimerus menglensis Huo & Ren, sp. n.
Distribution. China (Yunnan).

Aspidimerus mouhoti Crotch, 1874
Aspidimerus mouhoti Crotch, 1874: 202. Korschefsky 1931: 172.
Aspidimerus sexmaculatus Pang & Mao, 1979: 55; Cao and Xiao 1984: 98; Cao et al. 1992: 133; Pang 1998: 186; Kovář 2007: 73, 575; Ren et al. 2009: 110. Synonymized by Kovář 2007: 73.
Distribution. China (Yunnan); Laos (Mouhot).

Aspidimerus nigritus (Pang & Mao, 1979)
Cryptogonus nigritus Pang & Mao, 1979: 61; Cao et al. 1992: 138.
Aspidimerus dongpaoensis Hoàng, 1982: 165. Synonymized by Kovář 2007: 73.
Aspidimerus nigritus (Pang & Mao): Kovář 2007: 71, 73, 575; Ren et al. 2009: 108. Combined by Kovář 2007: 71.
Distribution. China (Yunnan); Vietnam.

Aspidimerus nigrovittatus Motschulsky, 1866
Aspidimerus nigrovittatus Motschulsky, 1866: 424; Crotch 1874: 202; Weise 1900: 428; Korschefsky 1931: 172; Poorani 2002: 343.
Distribution. Sri Lanka.

Aspidimerus ruficrus Gorham, 1895
Aspidimerus ruficrus Gorham, 1895: 690; Korschefsky 1931: 173; Kapur 1948: 83; Pang and Mao 1979: 55; Cao and Xiao 1984: 98; Cao et al. 1992: 134; Pang 1998: 186; Kovář 2007: 575; Ren et al. 2009: 108; Poorani 2002: 343.
Cryptogonus blandus Mader, 1954: 130; Liu 1963: 84.
Aspidimerus blandus (Mader, 1954): Kovář 2007: 73. Combined by Kovář 2007: 73. syn. n.
Distribution. China (Sichuan, Yunnan); Vietnam; Burma.

Aspidimerus spencii Mulsant, 1850
Aspidimerus spencii Mulsant, 1850: 944; Crotch 1874: 202; Weise 1885: 232; Korschefsky 1931: 173; Kapur 1948: 83; Poorani 2002: 343.
Distribution. India; Burma.

Aspidimerus zhenkangicus Huo & Ren, sp. n.
Aspidimerus zhenkangicus Huo & Ren, sp. n.
Distribution. China (Yunnan).

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RESEARCH ARTICLE

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Three new species of the genus *Probles* Förster (Hymenoptera, Ichneumonidae, Tersilochinae) from South Korea

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Abstract

Three closely related species of the genus *Probles* Förster, *P. fulgida* **sp. n.**, *P. korusa* **sp. n.** and *P. rukora* **sp. n.**, belong to the subgenus *Euporizon* Horstmann and differ from other Palearctic species of the genus by a combination of long and apically weakly sinuate ovipositor and short temple. These three species are assigned to a newly designated *fulgida* species-group, and a portion of the key for identification of this species-group is provided. Based on the shape of the ovipositor apex, the *fulgida* species-group resemble members of the subgenus *Microdiaparsis* Horstmann but are distinct in having a much shorter temple.

Keywords

Euporizon, *Probles*, Tersilochinae, Palearctic region, South Korea, taxonomy, key

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Introduction

Probles is a predominantly Holarctic genus (Nearctic species are mostly undescribed) with about 44 species in the Palearctic region (Yu et al. 2012) and some undescribed species in the Afrotropical and Oriental regions and Australia (Gauld 1984; Khalaim 2007b, 2011). Townes (1971) mentioned a worldwide distribution of this genus but it probably does not occur in South America (Khalaim pers. data). The Palearctic fauna of *Probles* is rather irregularly studied: West European species were revised by Horstmann (1971, 1981; Horstmann and Kolarov 1988), and Palearctic species of five small subgenera, *Microdiaparsis* Horstmann, *Probles* s. str., *Rhynchoprobles* Horstmann and *Rugodiaparsis* Horstmann, were reviewed in two papers by Khalaim (2003, 2007a), whereas the most species rich subgenus, *Euporizon* Horstmann, is virtually unstudied outside Europe. Some species of *Probles* have been recorded as parasitoids of the beetle families Ciidae, Curculionidae, Endomycidae, and Melandryidae in Europe (Horstmann 1971, 1981).

Only two species of *Euporizon*, *P.* (*E.*) *sibirica* Khalaim, 2007 from Mongolia and Russian Siberia and *P.* (*E.*) *vulnifica* Khalaim & Sheng, 2009 from the Palearctic part of China, are known to occur in the East Palearctic region, and one Oriental species, *P.* (*E.*) *vietnamica* Khalaim, 2011, was recently described from Vietnam (Khalaim 2007a, 2011; Khalaim and Sheng 2009). Six more undescribed species of *Euporizon* were reported from South Korea and Vietnam by Khalaim (2011).

Six tersilochine genera, including *Probles*, were found to occur in South Korea; and a key to these genera was provided in our previous paper on Korean Tersilochinae (Balueva et al. 2013). One abundant undescribed species of *Euporizon* comprises over half of the entire Korean material of *Probles* (Balueva et al. unpubl.). In this paper, we describe three closely related new species of *Euporizon* belonging to one species-group (designated here) and provide a portion of the key for identification of these species.

Materials and methods

This work is based on material of the Ichneumonidae collection of the Yeungnam University (Gyeongsan, South Korea, further YNU). More than 100 specimens of the genus *Probles* have been studied. From this material, three closely related species of the genus *Probles* are described. Most specimens, including all holotypes, are kept at Yeungnam University, with some specimens deposited at the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (further ZISP) and the Natural History Museum, London, United Kingdom (further BMNH).

Photographs were taken at ZISP using a DFC290 digital camera attached to a Leica MZ16 stereomicroscope; partially focused photographs were combined using Helicon Focus software.

Morphological terminology predominantly follows Townes (1969) with changes according to Khalaim (2011).

Systematics

Genus *Probles* Förster, 1869
http://species-id.net/wiki/Probles

Type species. *Probles melanarius* Szépligeti, 1895 (= *Porizon erythrostomus* Gravenhorst, 1829).

The genus belongs to the *Tersilochus* genus-group (Horstmann 1981) by having the first metasomal segment with a furrow between the glymma and the ventral part of the postpetiole, and the propodeum usually has a basal area (rarely with basal keel). *Probles* differs from other genera in this genus-group by the well-developed foveate groove of the mesopleuron, which is more or less upcurved anteriorly, elongate thyridial depression, weakly curved hind tibial spurs, and simple tarsal claws. Additional characters for distinguishing *Probles* from other Korean tersilochine genera are given in the key published in our previous paper (Balueva et al. 2013).

Subgenus *Euporizon* Horstmann, 1971

Type species. *Thersilochus rufipes* Holmgren, 1860.

Euporizon is the least specialized and the most species rich subgenus of *Probles*, comprising about 36 species in the Palearctic region. This is the only subgenus of *Probles* found in South Korea.

Portion of the key to Korean species of Euporizon

1 Ovipositor weakly sinuate at apex (Figs 10, 18, 24); sheath about 2.5 times as long as first tergite. Temple short, 0.4–0.5 times as long as eye width and very strongly rounded behind eyes in dorsal view (Figs 4, 13, 20). Vertex with sharp and dense punctures on smooth background, distance between punctures mostly less than one diameter of puncture (Fig. 20). Flagellomeres 2 to 6(7) bearing subapical finger-shaped structures on outer surface (Fig. 6, arrows)..... ***fulgida* species-group, 2**

– Ovipositor not sinuate at apex; sheath usually shorter. Temple longer and/or less rounded behind eyes in dorsal view. Vertex impunctate or finely punctate on smooth or granulate background (distance between punctures greater than one puncture diameter). Formula of finger-shaped structures of flagellum usually not as above ..... **Other species of *Probles* (*Euporizon*)**

2 Foveate groove relatively weak, situated in centre of mesopleuron and not reaching prepectal carina anteriorly (Figs 5, 6). Flagellum with 22 segments (Fig. 2). Clypeus, in lateral view, flat. Wings with distinct yellowish tinge. Ovipositor rather strongly sinuate at apex (Fig. 10)..... ***fulgida* sp. n.**

– Foveate groove extending almost entire length of mesopleuron and usually reaching prepectal carina anteriorly (Figs 15, 21). Flagellum with 18–20 segments (Fig. 12). Clypeus, in lateral view, weakly but distinctly convex. Wings with very slight yellowish tinge. Ovipositor weakly sinuate at apex (Figs 18, 24).....**3**

3 Ovipositor with apex very thin and strongly upcurved (Fig. 18) ..... ***korusa* sp. n.**

– Ovipositor slightly sinuate at apex, neither especially thin nor strongly upcurved (Fig. 24) ..... ***rukora* sp. n.**

fulgida species-group

Remarks. This species-group is designated here for the first time as comprising three Korean species based on characters given in the key. This species-group resembles the subgenus *Microdiaparsis* as both have an apically sinuate ovipositor but is distinct in having a much shorter temple, which is about as long as the eye width in *Microdiaparsis* and only 0.4–0.5 times as long as the eye width in the *fulgida* species-group.

Description. Head very strongly constricted and strongly rounded behind eyes in dorsal view (Figs 4, 13, 20); temple short, 0.4–0.5 times as long as eye width. Upper tooth of mandible somewhat longer than lower tooth. Clypeus slightly truncate apically, smooth, punctate in upper part. Malar space 0.7–0.8 times as long as basal width of mandible. Flagellum filiform, usually slightly clavate at apex (Figs 2, 12); subbasal flagellomeres 1.7–1.9 times as long as broad, subapical flagellomeres slightly elongate; flagellomeres 2 to 6(7) bearing apical finger-shaped structures on outer surface (Fig. 6). Vertex with sharp and dense punctures on smooth background, distance between punctures mostly shorter than one diameter of puncture (Fig. 20). Temple smooth and shining, with fine and moderately dense punctures. Hypostomal carina absent. Occipital carina complete.

Notaulus with distinct wrinkle adjacent to anterolateral margin of mesoscutum (Fig. 20). Mesoscutum densely punctate, granulate, dull. Scutellum with lateral longitudinal carinae developed in its anterior 0.3–0.4. Foveate groove well developed, S-curved, crenulate (Figs 15, 21). Mesopleuron centrally (above foveate groove) distinctly punctate, smooth and shining between punctures (Figs 5, 15). Propodeum with more or less rectangular, usually slightly widened anteriorly basal area, which is 1.5–2.0 times as long as broad and 0.35–0.5 times as long as apical area (Figs 7, 14, 22). Dorsolateral area finely granulate, sometimes almost smooth centrally, finely punctate or impunctate. Propodeal spiracle separated from pleural carina by 1.0–2.0 times diameter of spiracle. Apical area flat, truncate anteriorly, granulate or uneven, impunctate.

Fore wing (Fig. 16) with second recurrent vein distinctly postfurcal; intercubitus about as long as abscissa of cubitus between intercubitus and second recurrent vein. Metacarp not reaching apex of fore wing. First abscissa of radius about 1.5 times as long as width of pterostigma. Postnervulus intercepted below middle. Hind wing (Fig. 16) with nervellus vertical or slightly reclivous.

Legs slender. Hind femur about 4.0 times as long as broad and 0.8–0.85 times as long as tibia. Hind spurs slightly curved at apex. Tarsal claws not pectinate.

First tergite 2.9–4.0 times as long as broad posteriorly; petiole centrally more or less trapeziform in cross-section, distinctly separated from postpetiole in dorsal view. Glymma moderately deep, situated behind centre of first tergite, joining by distinct furrow to ventral part of postpetiole (Figs 8, 17, 21). Second tergite 1.55–1.65 times as long as anteriorly broad (Figs 9, 23). Thyridial depression well developed, deep, about 2.5–3.0 times as long as broad (Figs 9, 23). Ovipositor weakly sinuate at apex (Figs 10, 18, 24); sheath about 2.5 times as long as first tergite.

Head, mesosoma, and first tergite black. Palpi and mandible (teeth reddish black) yellow. Clypeus brownish yellow in lower 0.3–0.4. Scape and pedicel of antenna yellowish; flagellum fuscous, a little paler basally. Tegula yellow to brownish. Pterostigma brown. Legs brownish yellow; hind coxa and femur (sometimes also mid coxa) brown, hind tibia infuscate. Metasoma behind first tergite usually brown, ventrally yellowish, tergites 2 to 5 dorsally usually with more or less distinct yellow band posteriorly (Fig. 9).

Composition. This species-group comprises three closely related species, *P. fulgida* sp. n., *P. korusa* sp. n. and *P. rukora* sp. n., occurring in South Korea.

***Probles* (*Euporizon*) *fulgida* Khalaim & Balueva, sp. n.**
http://zoobank.org/0F412ACA-A932-4669-9B03-517C2F45B55B
http://species-id.net/wiki/Probles_fulgida
Figs 1–10

Holotype. Female (Fig. 1), SOUTH KOREA: Gyeongsangnam-do, Sancheong-gun, Sicheon-myeon, Mt. Jiri, Jangdanggol, 35°20'N, 127°43'E, 11.VIII–8.IX.2001, coll. J.W. Lee (YNU).

Comparison. Differs from the two other members of the *fulgida* species-group, *P. korusa* sp. n. and *P. rukora* sp. n., by the weaker and shorter foveate groove of the mesopleuron (Fig. 5), 22-segmented antennal flagellum (Fig. 2), flat clypeus (in lateral view), wings more extensively tinged with yellow, and more strongly sinuate apex of the ovipositor (Fig. 10).

Description. Female: Body length 5.5 mm; fore wing length 3.85 mm. Head with temple almost half as long as eye width in dorsal view (Fig. 4). Clypeus flat in lateral view, smooth, distinctly and densely punctate on upper half (Fig. 3). Malar space 0.7 times as long as basal width of mandible (Fig. 6). Antennal flagellum with 22 segments (Fig. 2); flagellomeres 2 to 7 bear subapical finger-shaped structures on outer surface (Fig. 6). Face and frons very finely granulate, dull, with sharp and dense punctures (Fig. 3). Temple with dense, fine and sharp punctures. Foveate groove relatively weak and short, situated near center of mesopleuron (Fig. 5). Mesopleuron almost entirely sharply and densely punctate, peripherally granulate (Figs 5, 6). Propodeum with basal longitudinal carinae anteriorly indistinct, basal area rectangular, about 1.6 times

Figures 1–5. *Probles fulgida* sp. n., ♀, holotype. **1** general habitus, lateral view **2** antennae, lateral view **3** head, frontal view **4** head, dorsal view **5** mesosoma, ventrolateral view.

as long as broad and 0.35 times as long as apical area (Fig. 7). Propodeal spiracle separated from pleural carina by 2.0 times diameter of spiracle. Apical longitudinal carinae mostly indistinct (Fig. 7). Hind femur 4.3 times as long as broad and 0.82 times as long as tibia. First tergite laterally before glymma finely striate, 2.9 times as long as broad posteriorly (Fig. 8). Second tergite 1.55 times as long as anteriorly broad (Fig. 9). Ovipositor distinctly sinuate at apex (Fig. 10); sheath about 2.5 times as long as first tergite. Metasoma behind first tergite extensively brownish yellow ventrally and laterally, tergites 2 to 5 dorsally and dorsolaterally brown (Fig. 1).

Male. Unknown.

Distribution. South Korea.

Etymology. Named from the Latin *fulgidus* (shining, gleaming, glittering).

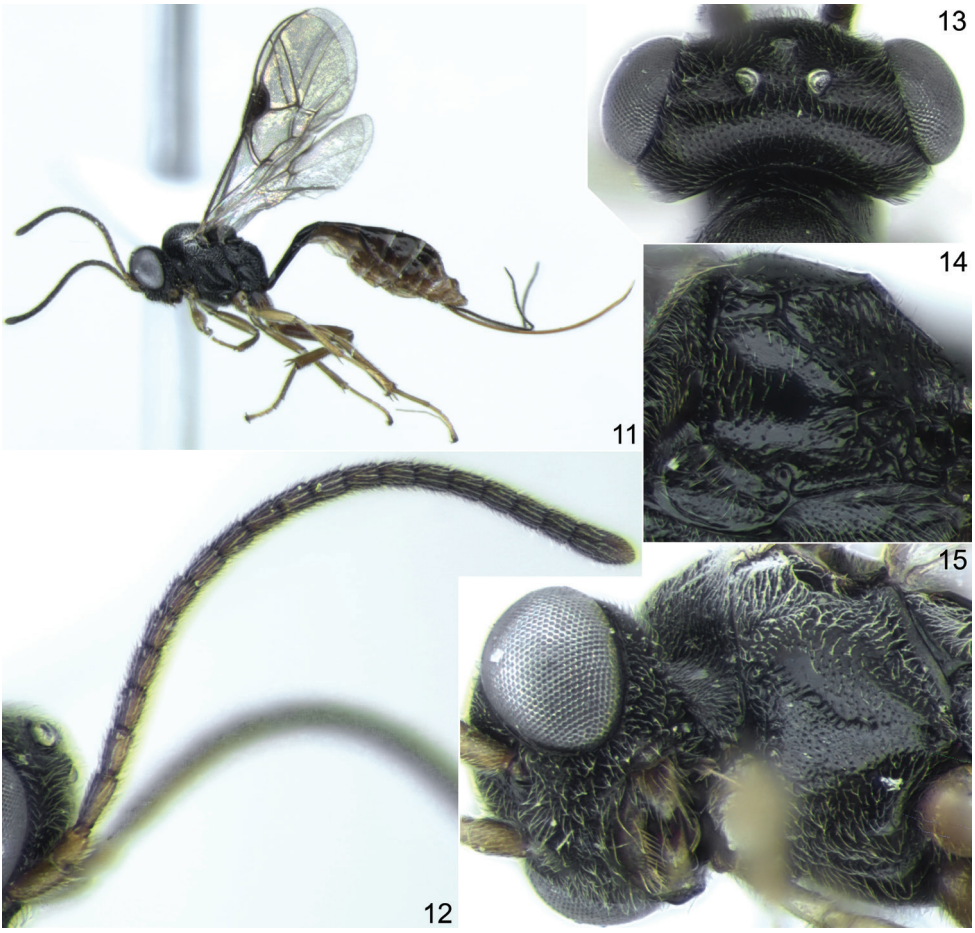
Figures 6–10. *Probles fulgida* sp. n., ♀, holotype. **6** head and mesosoma, lateral view **7** propodeum, dorso-postero-lateral view **8** first metasomal segment, lateral view **9** second and third segments of metasoma, dorsal view **10** apex of ovipositor, lateral view.

***Probles* (*Euporizon*) *korusa* Khalaim & Kim, sp. n.**

http://zoobank.org/25EF822B-B580-43F5-AC32-DAA0D6C5336A
http://species-id.net/wiki/Probles_korusa
Figs 11–18

Holotype. Female (Fig. 11), SOUTH KOREA: Gyeongsangbuk-do, Cheongdo-gun, Unmun mueon, Ssalbawi, 35°38'08"N, 129°01'27"E, 29.VI–10.VII.2012, coll. J.W. Lee (YNU).

Paratypes. SOUTH KOREA: Chungcheongbuk-do: Danyang-gun, Cheondong-ri, Mt. Sobaeksan, 37°00'N, 128°31'E, Malaise trap, 21.VI–6.VII.2006, coll. J.W. Lee, 1 ♀ (YNU). Gyeonggi-do: Yangpyeong, Yongmun, Yeonsu, Mt. Yongmunsan,

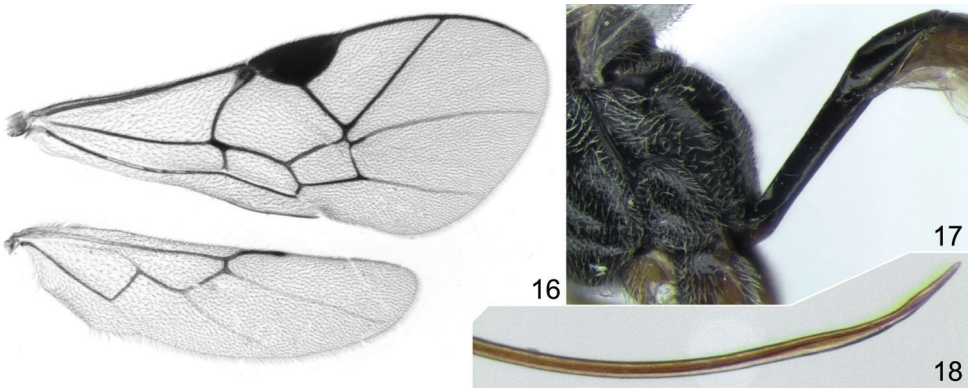


Figures 11–15. *Probles korusa* sp. n., ♀, holotype (except Fig. **14**). **11** general habitus, lateral view **12** antenna, lateral view **13** head, dorsal view **14** propodeum, dorsolateral view **15** head and mesopleuron, ventrolateral view.

324 m, 37°31'48.9"N, 127°34'23.8"E, Malaise trap, 11–25.VI.2009, coll. J.O. Lim, 1 ♀ (YNU). Mt. Yongmunsan, Yeonsu, Yongmun, Yangpyeong, 324 m, 37°31'48.9"N, 127°34'23.8"E, 11–25.VI.2009, coll. J.W. Lim, 1 ♀ (ZISP). Gyeongsangbuk-do: same data as holotype, 3 ♀♀ (YNU, 1 ♀ in ZISP). Jeollabuk-do: Jeongeup-si, Naejang-dong, Geumseong, Malaise trap, 20.VI.2005, coll. D.K. Chung, 1 ♀ (YNU).

Additional material. RUSSIA: Primorskiy reg., 30 km SE of Ussuriysk, mixed forest, 15.VII.2001, coll. S.A. Belokobylskij, 1 ♀ (ZISP).

Comparison. Very similar to *P. rukora* sp. n. but the ovipositor has the apex thinner and strongly upcurved (Fig. 18), whereas in *P. rukora* sp. n. the ovipositor is just slightly sinuate apically with the extreme apex neither especially thin nor strongly upcurved (Fig. 24). No other differences were found between these two species but the shape of the ovipositor apex works very well in separating all specimens without intermediate



Figures 16–18. *Probles korusa* sp. n., ♀, paratype (Fig. **16**) and holotype (Figs **17, 18**). **16** wings **17** posterior part of metasoma and first tergite, lateral view **18** apex of ovipositor, lateral view.

forms and both species are represented in our material by many specimens. Thus, we consider *P. korusa* sp. n. and *P. rukora* sp. n. to be distinct species. *Probles korusa* sp. n. also resembles the European species *P. curvicauda* Horstmann, 1981, which also has a long ovipositor with strongly upcurved apex, but is distinct in having much shorter temple, a wider basal area of the propodeum and a somewhat shorter ovipositor sheath.

Description. Female: Body length 4.5 mm; fore wing length 3.15 mm. Head with temple 0.45 times as long as eye width in dorsal view (Fig. 13). Clypeus weakly convex in lateral view, densely punctate on upper 0.6, finely granulate near upper margin. Malar space about 0.8 times as long as basal width of mandible (Fig. 15). Antennal flagellum with 19–20 segments (19 segments in holotype) (Fig. 12). Face and frons very finely granulate, dull, with sharp and dense punctures. Temple with dense, fine and sharp punctures. Foveate groove long, extending across anterior 0.8 of mesopleuron (Fig. 15). Propodeum with basal area about 1.5 times as long as broad and almost half as long as apical area (Fig. 14); basal longitudinal carinae sometimes indistinct and propodeum with longitudinal wrinkles dorsally. Propodeal spiracle separated from pleural carina by 1.0–2.0 times diameter of spiracle. Apical longitudinal carinae usually weak, anteriorly usually indistinct. Hind femur 4.1 times as long as broad and 0.82 times as long as tibia. First tergite laterally before glymma mostly smooth, 4.0 times as long as broad posteriorly. Second tergite 1.65 times as long as anteriorly broad. Ovipositor weakly sinuate apically, with extreme apex thin and strongly uncurved (Fig. 18); sheath about 2.6 times as long as first tergite. Metasoma behind first tergite predominantly brown, yellowish ventrally, tergites 2–3(4) dorsally dark brown (Fig. 11).

Male. Unknown.

Variation. The holotype has rather weak punctures on the temple. A female from the Russian Far East corresponds well with Korean material of this species but has the vertex conspicuously impressed posteriorly, weak notaulus, and a weaker foveate groove of the mesopleuron, and it may belong to a new species. This specimen is not included in the type series, and study of additional material is required to solve its status.

Distribution. South Korea, Russian Far East (Primorskiy reg.).

Etymology. Combination of initial letters of Korea and Russia, home countries of the participants in this paper.

***Probles* (*Euporizon*) *rukora* Khalaim & Lee, sp. n.**
http://zoobank.org/BE207642-1A2E-4ACB-B9E3-A08CCE61FFE7
http://species-id.net/wiki/Probles_rukora
Figs 19–24

Holotype. Female (Fig. 19), SOUTH KOREA: Chungcheongbuk-do, Boeun-gun, Songnisan, Deopjusameapyoso, 36°32'06"N, 127°49'40"E, 12–21.VI.2007 (YNU).

Paratypes. SOUTH KOREA: Gangwon-do: Inje-gun, irin-muen, Jindong-ri, Jeombongsan, 26.VI–28.VII.2012, coll. J.Y. Park, 1 ♀ (ZISP). Gyeongsangbuk-do: Cheongdo-gun, Unmun-myeon, Mt. Unmunsan, 35°38'45"N, 128°57'33"E, Malaise trap, 1–24.VII.2008, coll. J.W. Lee, 1 ♀ (YNU). Gyeongsangnam-do: Yeongju-si, Punggi-eup, Jungnyeong, 35°53'42.7"N, 128°26'22"E, 12–23.VII.2008, coll. J.M. Kwon, 1 ♀ (YNU).

Comparison. Very similar to *P. korusa* sp. n. but the ovipositor is very weakly sinuate apically, with the extreme apex neither especially thin nor strongly upcurved (Fig. 24), whereas in *P. korusa* sp. n. the ovipositor is very thin and strongly upcurved at the extreme apex (Fig. 18). See also Comparison section for *P. korusa* sp. n.

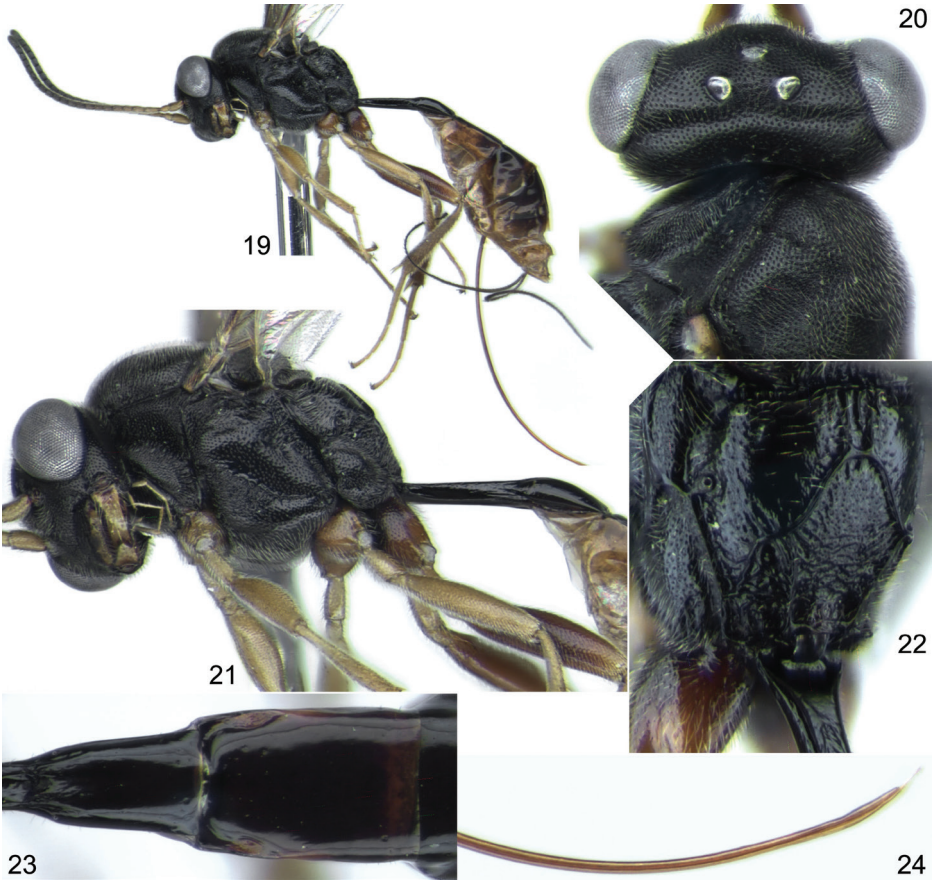
Description. Female: Body length 5.4 mm. Fore wing length 3.75 mm. Head with temple 0.42 times as long as eye width in dorsal view (Fig. 20). Clypeus weakly convex in lateral view, densely punctate on upper 0.6. Malar space 0.7–0.8 times as long as basal width of mandible. Antennal flagellum with 20 segments. Face and frons very finely granulate, dull, with sharp and dense punctures. Temple with dense and fine punctures. Foveate groove long, extending across anterior 0.8 of mesopleuron (Fig. 21). Propodeum with basal area 1.5–2.0 times as long as broad and 0.37 times as long as apical area (Fig. 22); basal longitudinal carinae sometimes indistinct and propodeum with longitudinal wrinkles dorsally. Propodeal spiracle separated from pleural carina by 1.0–2.0 times diameter of spiracle. Apical longitudinal carinae weak anteriorly. Hind femur 3.9 times as long as broad and 0.84 times as long as tibia. First tergite laterally mostly smooth, before glymma partly striate, 3.8 times as long as broad posteriorly. Second tergite 1.65 times as long as anteriorly broad (Fig. 23). Ovipositor very weakly sinuate apically (Fig. 24); sheath about 2.5 times as long as first tergite. Metasoma behind first tergite predominantly brown, yellowish ventrally, dorsally mostly dark brown (Fig. 19).

Male. Unknown.

Distribution. South Korea.

Variation. This is a rather uniform species with no obvious variation in structure and coloration.

Etymology. Combination of initial letters of Russia and Korea, home countries of the participants in this paper.



Figures 19–24. *Probles rukora* sp. n., ♀, holotype. **19** general habitus (without wings), lateral view **20** head and anterior part of mesosoma, dorsal view **21** head, mesosoma and first tergite, lateral view **22** propodeum, dorsolateral view **23** second tergite, dorsal view **24** apex of ovipositor, lateral view.

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We thank the anonymous reviewers for valuable critical comments and suggestions. This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR No. 2013-02-001), by the National Institute of Biological Resources (NIBR) of Ministry of Environment, KOREA (1834-302), and the Russian Foundation for Basic Research (grant no. 13-04-00026).

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Discovery of the male of *Lobrathium rotundiceps* (Koch), and a new species of *Lobrathium* from Jiangxi, East China (Coleoptera, Staphylinidae, Paederinae)

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Abstract

The male of *Lobrathium rotundiceps* (Koch, 1939) from Zhejiang and *L. luoxiaoense* **sp. n.** from Jiangxi are described and illustrated.

Keywords

Lobrathium rotundiceps, taxonomy, male, new species, China

Introduction

Lobrathium rotundiceps was described by Koch (1939) as *Lathrobium rotundiceps* based on a single female collected from "Tienmuschan N.W. China", but never recorded again since. Assing (2012) revised, redescribed, and illustrated the female holotype. The male sexual characters, however, which are of great significance for taxonomy

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of *Lobrathium* species, were unknown. Recently, additional specimens of *Lobrathium rotundiceps*, among them males, were collected in Zhejiang, or found in the collections of Shanghai Normal University.

In July 2013, two colleagues sifted two specimens of an undescribed *Lobrathium* in Jiangxi.

Material and methods

The specimens treated in this study are deposited in the following public collections: The Insect Collection of Shanghai Normal University, Shanghai, P. R. China (**SNUC**); Naturhistorisches Museum Basel, Switzerland (**NHMB**).

The labels of type specimens are cited in their original spelling. A slash (/) is used to separate different labels.

All measurements are in millimeters. The following abbreviations are used: **BL**–length of the body from the anterior margin of the mandibles (in resting position) to the abdominal apex; **HL**–length of the head from the anterior margin of the frons to the posterior margin of the head; **HW**–maximum width of the head; **PL**–length of the pronotum along the midline; **PW**–maximum width of the pronotum; **EL**–length of the elytra from the anterior margin to the posterior elytral margin along suture; **EW**–maximum width of the elytra; **AL**–length of the aedeagus from the apex of the ventral process to the base of the aedeagal capsule.

Taxonomy

***Lobrathium rotundiceps* (Koch, 1939)**
http://species-id.net/wiki/Lobrathium_rotundiceps
Figs 1, 2

Lathrobium rotundiceps Koch, 1939: 163.
Lobrathium rotundiceps (Koch): Assing 2012: 107 (redescription).

Type material studied. Holotype ♀ : "Tienmuschan, N.W. China Rtt./ Type / *Lathrobium rotundiceps* Koch, det. C. Koch / Holotypus 1956, det. Kamp / Holotypus *Lathrobium rotundiceps* Koch / *Domene rotundiceps* (Koch) ♀, V.I. Gusarov det. 1993 / *Lobrathium rotundiceps* (Koch), det. V. Assing 2012" (NHMB).

Koch (1939) described *Lathrobium rotundiceps* Koch from a single female, from "Tienmuschan N.W. China". Zheng (1988) included *Lobrathium rotundiceps* (Koch) in his key to species based on the original description. Recently, Assing (2012) redescribed the species based on the holotype, and pointed out that the type locality specified in the description ("Tienmuschan N.W. China") was in "northeastern (not northwestern) China".

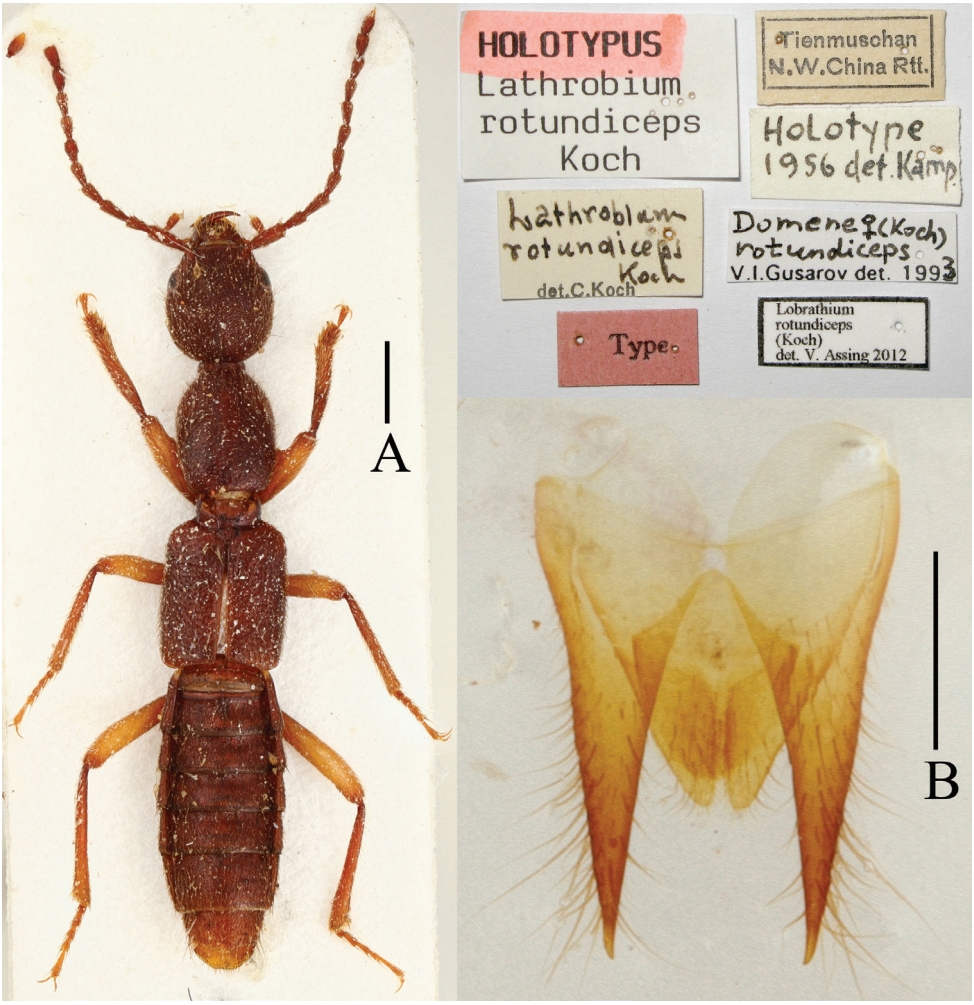

Figure 1. *Lobrathium rotundiceps*, holotype. **A** habitus **B** female tergites IX–X. Scales: **A** 1 mm, **B** 0.5 mm.

Additional material studied. China, Zhejiang (12 ♂♂, 1 ♀)**:** 3 ♂♂, Lin'an City, Tianmu Shan, 800–1150 m, 19–V–2006, Hu & Tang leg.; 5 ♂♂, Anji City, Longwang Shan, Qianmutian 4.8 km, 1050–1250 m, 08–VI–2012, Hu & Yin leg.; 4 ♂♂, Longwang Shan, Qianmutian, 1300 m, 29–V–2009, Yuan et al. leg.; 1 ♀, Longwang Shan, 1250–1450 m, 14–V–2013, Tang leg. (SNUC)

Description of male. Body length: 8.87–9.62 mm, fore body length: 4.67–5.06 mm. HL/HW=1.08–1.10, PW/HW=0.87–0.96, EL/PL=0.92–1.01. Antenna 3.50–3.78 mm long.

Sternite VII (Fig. 2D) strongly transverse and without impression, posterior margin broadly concave; sternite VIII (Fig. 2E) weakly transverse, with long and pronounced postero-median impression, this impression with numerous modified, stout and short black setae, posterior margin weakly concave in middle, near this concavity

with cluster of dense fine setae; aedeagus (Figs 2B, 2C) 1.27–1.35 mm long, ventral process bifid in ventral view.

Comparative notes. *Lobrathium rotundiceps* shares a bifid ventral process with *L. digitatum* Assing 2010 and *L. bidigitatum* Assing 2010 from Taiwan, but differs from them in many respects, particularly by much larger body size, the different shape and chaetotaxy of the male sternite VIII, and by the shape of the aedeagus.

Intraspecific variation. The specimens from Qianmutian, 1050–1250 m are of darker coloration than those from Qianmutian, 1300 m, and Tianmu Shan, 800–1150 m.

Habitat and distribution. The specimens were sifted from debris and moss in moist habitats. Tianmu Shan is a mountain with high biodiversity in Lin'an City in northwestern Zhejiang province in eastern China, its altitude ranging from 300 to 1506 m (Wu and Pan 2001). Longwang Shan is one peak of the Tiammu Shan range and situated about 5 km northwards of the West Tianmu Shan.

Lobrathium luoxiaoense sp. n.

http://zoobank.org/8DE9CF08-3407-4FBB-814D-1CCF0AA0CC0A
http://species-id.net/wiki/Lobrathium_luoxiaoense
Fig. 3

Type material (1 ♂, 1 ♀)**. Holotype**, ♂: "China, Jiangxi, Pingxiang City, 27°34'15"N, 114°14'12"E, near Luxi County, Yangshimu Area, entrance, moss on rock in a stream, sifted, ca. 995 m, 16–VII–2012, Xiao-Bin Song leg. / Holotype ♂, *Lobrathium luoxiaoense*, sp. n., Li et al., det. 2013". **Paratype**, ♀: "China, W. Jiangxi, Yichun City, Mingyueshan National Park, 27°35'43-41"N, 114°16'25"E, nr. Cableway station, moss on rock in a stream, sifted, ca. 1130 m, 13–VII–2013, Zi-Wei Yin leg." (SNUC)

Description. Body length 7.56–7.67 mm, length of fore body 3.50–3.73 mm. Habitus as in Fig. 3A. Coloration: body black, elytra with blue hue, and anterior portion of posterior half with yellowish spot not reaching posterior and lateral margins; legs dark brownish with paler tarsi; antennae dark reddish.

Head distinctly transverse (HL/HW = 0.90–0.91); posterior angles marked; punctation coarse and dense, sparser in median dorsal portion, interstices without microsculpture. Eyes large, more than half as long as distance from posterior margin of eye to neck. Antenna slender, 2.06–2.11 mm long.

Pronotum slender (PL/PW = 1.17–1.21), 0.93–0.96 times as wide as head, lateral margins weakly convex in dorsal view; punctation dense, coarser than that of head, midline moderately broadly impunctate; interstices without microsculpture and glossy.

Elytra broad and moderately short (EL/EW = 0.94–0.95, EW/PW = 1.17–1.23, EL/PL = 0.95–0.97); humeral angles marked; punctation coarse and arranged in distinct series, interstices without microsculpture and glossy. Hind wings fully developed.

Abdomen slightly broader than elytra; punctation fine and dense; posterior margin of tergite VII with palisade fringe; posterior margin of tergite VIII weakly convex, without appreciable sexual dimorphism.

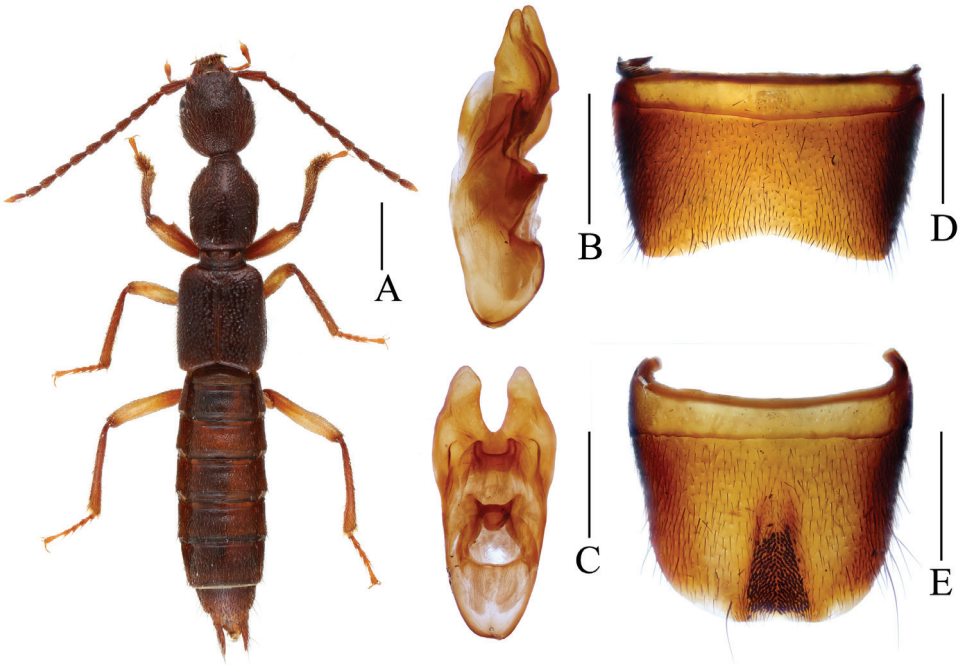

Figure 2. *Lobrathium rotundiceps*. **A** habitus **B** aedeagus in lateral view **C** aedeagus in ventral view **D** male sternite VII **E** male sternite VIII. Scales: **A** 1 mm, **B**–**E** 0.5 mm.

Male. Sternite VII (Fig. 3D) with deep and very narrow and shallow median impression with pubescence, posterior margin broadly concave, weakly convex in middle; sternite VIII (Fig. 3E) weakly transverse, with deep and pronounced postero-median impression, this impression with numerous (about 60) modified, stout and short black setae, posterior excision relatively small, near posterior excision with long dark setae; aedeagus (Figs 3B, C) 1.42 mm long, ventral process long and broad, apically convex in ventral view.

Female. Posterior margin of tergite VIII weakly convex in middle; posteriorly margin of sternite VIII broadly convex.

Etymology. The specific epithet (adjective) is derived from the Luoxiao Shan range where the type locality is situated.

Comparative notes. This species is highly similar to *L. anatitum* Li & Li (2013) in external (habitus, position of the elytral spots) and male sexual characters (modifications of the male sternites VII and VIII; shape of the ventral process of the aedeagus). The new species differs from *L. anatitum* by the narrower median impression of the male sternite VII, by the less extensive median cluster of modified setae and the smaller posterior excision of the male sternite VIII, as well as by the shape of the ventral process of the aedeagus (apex more acute in ventral view). For illustrations of *L. anatitum* see Li et al. (2013).

Habitat and distribution. The specimens were sifted from moss on stones in two streams, Jiangxi, East China.

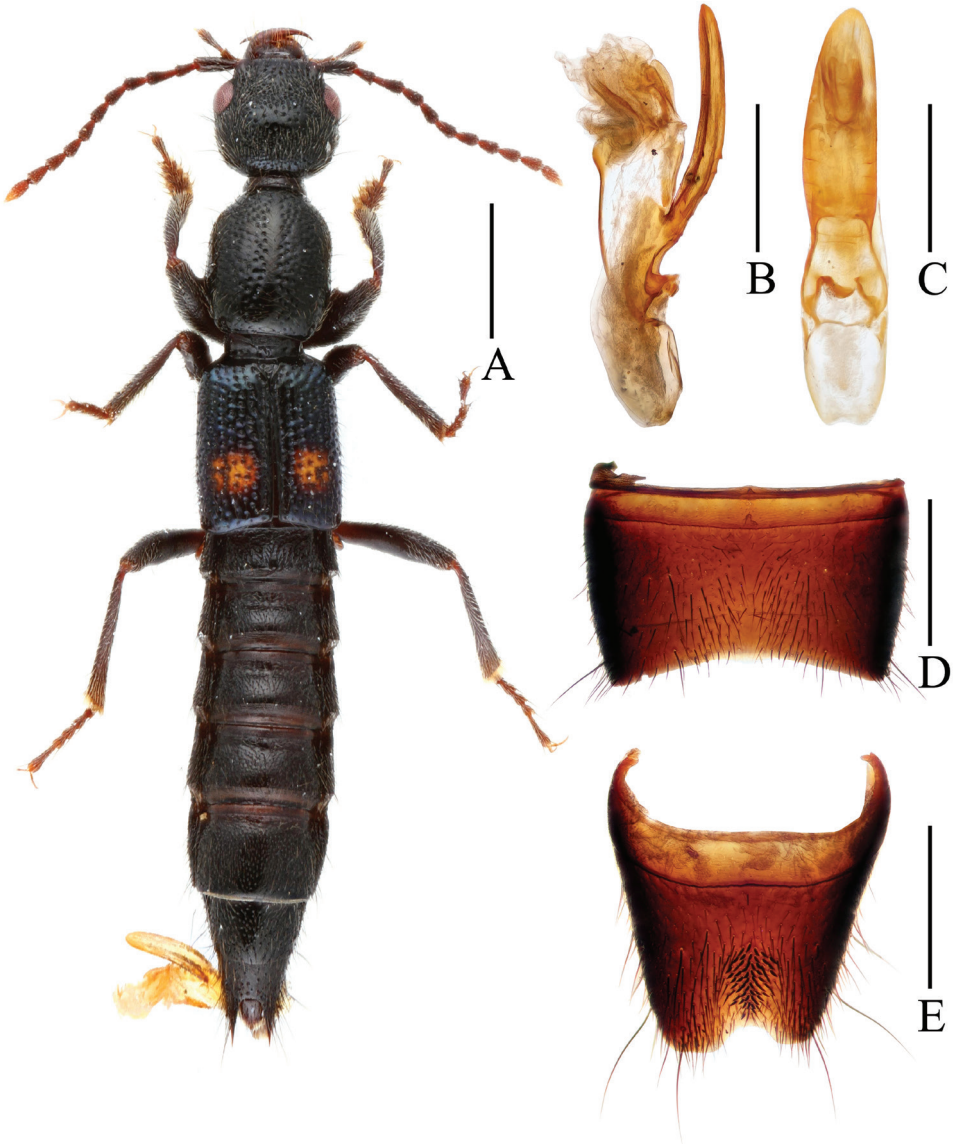

Figure 3. *Lobrathium luoxiaoense*. **A** habitus **B** aedeagus in lateral view **C** aedeagus in ventral view **D** male sternite VII **E** male sternite VIII. Scales: **A** 1 mm, **B**–**E** 0.5 mm.

Acknowledgements

We thank Isabelle Zürcher and Daniel Burckhardt (Basel, Switzerland) for the loan of the holotype of *Lobrathium rotundiceps*. Jia-Yao Hu (Shanghai, China) produced the habitus illustration of *L. rotundiceps*. All colleagues mentioned in the text are thanked for the collection of specimens. Volker Assing (Hannover, Germany) and Zi-Wei Yin (Shanghai, China) are acknowledged for reviewing the manuscript. The present paper

is supported by the National Natural Science Foundation of China (No. 31101659) and the State Scientific and Technological Commission (No. 2013FY111500) and Shanghai Normal University (DZL125).

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RESEARCH ARTICLE

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Occurrence of species of the genus *Pityophthorus* Eichhoff (Coleoptera, Curculionidae, Scolytinae) in the province of Quebec, Canada

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Abstract

Twig beetles in the genus *Pityophthorus* Eichhoff, 1864 include more than 300 species worldwide, with maximum diversity in tropical and subtropical regions. To date, approximately 50 species of *Pityophthorus* have been recorded in Canada, and these species are associated mainly with coniferous trees. Since 1981, no comprehensive study on this difficult taxonomic group has been conducted in Quebec, Canada, most likely due to their limited significance as forest pests. Based on data gathered from five years of field sampling in conifer seed orchards and compiled from various entomological collections, the distribution of *Pityophthorus* species in Quebec is presented. Approximately 291 new localities were recorded for the *Pityophthorus* species. Five species-group taxa, namely *P. puberulus* (LeConte, 1868), *P. pulchellus pulchellus* Eichhoff, 1869, *P. pulicarius* (Zimmermann, 1868), *P. nitidus* Swaine, 1917, and *P. cariniceps* LeConte&Horn, 1876 were the most widespread. In contrast, *P. consimilis* LeConte, 1878, *P. intextus* Swaine, 1917, *P. dentifrons* Blackman, 1922, *P. ramiperda* Swaine, 1917, and *P. concavus* Blackman, 1928 display a notably limited distribution. In addition, the first distribution records of *P. intextus* and *P. biovalis* Blackman, 1922 are furnished, and the subspecies *P. murrayanae murrayanae* Blackman, 1922 is reported from Quebec for the second time. Moreover, distribution maps are provided for all *Pityophthorus* species recorded in the province of Quebec.

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Keywords
Distribution, fauna, locality, Quebec, records, twig beetle

Introduction

Twig beetles in the genus *Pityophthorus* Eichhoff, 1864 include approximately 386 species distributed worldwide (Bright 1981; Bright and Skidmore 1997, 2002; Wood and Bright 1992) with 218 species found in North and Central America (Bright 1981; Wood 1982), and approximately 55 other species found in South America (Wood 2007). More than 70 % of the *Pityophthorus* world fauna is distributed in North, Central, and South America. Wood (2007) notes that the genus *Pityophthorus* has an American origin and displays its maximum diversity in subtropical and tropical areas. A vast majority of the North and Central American species of this genus breed in twigs of coniferous trees (Bright 1981; Wood 1982), whereas the South American species breed predominantly in deciduous trees (Wood 2007).

Excluding the taxonomic works, twig beetles have received little attention from the scientific community and forest managers simply because these organisms generally colonize declining trees or tree parts. They are often found in thin-barked parts of stressed or weakened trees, and they are rarely associated with extensive epidemics in forest ecosystems (Furniss and Carolin 1977). Nevertheless, some reports have indicated that several *Pityophthorus* species may become problematic and cause medium to severe damage in coniferous plantations (Rappaport and Wood 1994; Stevens et al. 1979). Furthermore, twig beetles may vector pathogenic fungi. For example, pitch canker disease of Monterey pine, *Pinus radiata* D. Don, is caused by wounding and transmission of a fungal pathogen to twigs during feeding by a complex of *Pityophthorus* sp. in California (Dallara 1997; Hoover et al. 1996; Sakamoto et al. 2007). In a Monterey pine plantation in Spain, approximately 25 % of the analyzed population of *Pityophthorus pubescens* (Marsham) was responsible for carrying the spores of *Fusarium circinatum* Nirenberg and O'Donnell, which is the fungus that causes pitch canker disease (Romón et al. 2007). More recently, Kolařik et al. (2011) reported that another *Pityophthorus* species, the walnut twig beetle, *P. juglandis* Blackman, is an important vector of the fungus *Geosmithia morbida* (M. Kolařik, E. Freeland, C. Utley and Tisserat 2011). This complex causes thousand cankers disease, which is a serious necrosis of the phloem of walnut trees, *Juglans* sp., in the United States (Seybold et al. 2013). The walnut twig beetle has expanded its range considerably in the U.S. (Cranshaw 2011; Seybold et al. 2012), which may explain the recent attention that the disease has attracted from the forest management community (Seybold et al. 2013).

The species of the genus *Pityophthorus* are difficult to identify with morphological techniques. Both sexes are often required for accurate identification at the species level (Bright 1981; Wood 1982, 2007). Taxonomic revisions of this genus in North America have been published by LeConte and Horn (1876), Swaine (1918), and Blackman (1928). Wood (1978) placed the genus *Pityophthorus* into the Corthylini and the

Pityophthorina (subtribe). The *Pityophthorus* are closely related to *Araptus* Eichhoff, 1872 whose species are found mainly in Mexico, Central, and South America (Wood 2007; Wood and Bright 1987, 1992). A major contribution to the knowledge of the *Pityophthorus* was provided by Bright (1981), who published a taxonomic monograph in which more than 220 species from Central and North America were described and classified.

In Canada, approximately 50 species of *Pityophthorus* have been recorded (Bright 1968; Bright 1971, 1976, 1981; Bright and Skidmore 1991, 1997, 2002; Bright et al. 1994; Wood and Bright 1987, 1992). In the province of Quebec, Canada, 17 species have been reported (Bright 1976, 1981; Bright and Skidmore 1997, 2002; Laplante et al. 1991; McNamara 1991; MRNQ 2008). However, no comprehensive and up-to-date study has been performed on the genus *Pityophthorus* in Quebec since the publications of D.E. Bright.

The purpose of this article is to update the distribution of all recorded *Pityophthorus* species in the province of Quebec, Canada. The species records are based on data collected from several entomological collections and on our own field-trapping data obtained during the last five years (2008–2012). A study of the distribution of *Pityophthorus* species is highly important, particularly in ecological and biological studies on different species and for further taxonomic revisions of this difficult bark beetle group. This study also provides background information for researchers working with exotic forest insects and for forest managers.

Methods and conventions

This article is based on data obtained from *Pityophthorus* specimens collected exclusively in the province of Quebec, Canada. Two different sources of data were used: field captures performed between 2008 and 2012 and a survey of public and private entomological collections.

Field collection methods. The field data included in this article were collected over a period of five years (2008–2012) from trapping activities conducted in six different seed orchards scattered from west to east over diverse types of landscapes in the province of Quebec (Table 1). These seed orchards are composed mainly of white pine, *Pinus strobus* L., but also contain specimens of red pine, *Pinus resinosa* Ait. and jack pine, *Pinus banksiana* Lamb., as well as white spruce, *Picea glauca* (Moench) Voss, red spruce, *Picea rubens* Sargent, and black spruce, *Picea mariana* Miller, Briton, Sterns & Poggenburg.

Two types of trapping techniques were used in the study sites. The first trapping technique employed "Yellow Japanese Beetle" (YJB) traps (Trécé Inc., Adair, Oklahoma, United States) equipped with 500-ml Mason® jars. Each jar was filled with 50 ml of propylene glycol to kill and preserve the trapped insects. The YJB traps were baited with a polyethylene "bubble cap" release device (Contech Enterprises Inc., Delta, British Columbia, Canada) that contained (±) *trans*-pityol (release rate of 0.2 mg/day). Pityol is an aggregation pheromone component of several *Pityophthorus* species

Table 1. The sampled seed orchards with their corresponding area in hectares, their geographic coordinates and the nearest locality.

Seed orchard	Nearest locality	Geographic coordinates (decimal degrees)	Area (ha)
Huddersfield	Fort-Coulonge	45.9215; -76.6219	9.7
Dorion	Lac Cayamant	46.0459; -76.2828	6.6
Verchères	Saint-Amable	45.6773; -73.3303	5.5
Cleveland	Saint-Claude	45.6764; -71.9954	2.5
Aubin-de-l'Isle	Saint-Simon-les-Mines	46.2089; -70.6780	4.5
Cap-Tourmente	Cap-Tourmente	47.0680; -70.8076	2.8

(Brauner and De Groot 2007; Dallara et al. 2000; De Groot and De Barr 2000; Francke et al. 1987; López et al. 2011). The population monitoring of *Pityophthorus* species in the six seed orchards was performed starting in 2008 and ending in 2012. The biological material was collected with an average frequency of twice a month from mid-April to the end of September.

A second trapping technique was used to increase the chance of capture of other *Pityophthorus* specimens that may not respond to synthetic pityol alone as an attractant. Twelve-unit Lindgren funnel traps were used to monitor *Pityophthorus* populations in three of the six previously mentioned seed orchards, namely Verchères, Huddersfield and Cleveland (Table 1). The Lindgren traps were placed at a density of approximately three traps per hectare and were baited with (±) *trans*-pityol and UHR ethanol (200 mg/day, Synergy Semiochemicals Corp., Burnaby, British Columbia). Ethanol is an attractant for large number of bark and ambrosia beetles (Miller and Rabaglia 2009). Lindgren traps were equipped with plastic trap cups filled with 50 ml of propylene glycol. The cups were emptied at the same frequency as described in the previous trapping technique. The field-collected *Pityophthorus* specimens were preserved in 70 % ethanol and subsequently mounted and pinned. All of the captured specimens originating from field trapping are preserved in the INRS-Institute Armand-Frappier (INRS-IAF) entomological collection. The species identification was performed according to morphological criteria by using a Discovery V-20 stereomicroscope (Carl Zeiss Canada Ltd.) equipped with an ICc3 video camera. Pictures of the identified and unidentified *Pityophthorus* species are available at the following web address: www.profs.inrs.ca/cguertin/ZOOKEYS_2013/MENU.html

The field data were complemented with information gathered from six public and two private entomological collections. In this article, the following acronyms are used for the public entomological collections:

CNC Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, ON, Canada;

MRNQ Ministère des Ressources Naturelles du Québec, Québec, QC, Canada;

LFRC Natural Resources Canada, Laurentian Forestry Research Center, René-Martineau Insectarium, Québec, QC, Canada;

ECLU Entomological Collection, Laval University, Québec, QC, Canada;
LEMU Lyman Entomological Collection, McGill University, Montreal, Quebec, Canada;
ROUM Robert-Ouellet Entomological Collection, Montreal University, Montreal, QC, Canada.

The acronyms used for the private entomological collections are the following:

CCC Claude Chantal's Collection, Varennes, QC, Canada
CLC Claire Lévesque's Collection, Sherbrooke, QC, Canada

The following two additional acronyms are also employed in this article:

SLWC S.L. Wood entomological collection. Although this collection was not directly examined, some *P. lautus* Eichhoff specimens captured in the province of Quebec are deposited there. Even though the specimens have not been examined, these are included in the article as reliable records that were published by Bright (1981).
INRS-IAF Entomological collection of the INRS-Institut Armand-Frappier, Laval, QC, Canada. All specimens collected during the field trapping activities are deposited in this collection.

Approximately 50 % of the specimens analyzed in this study belong to MRNQ entomological collection. In general, to capture bark beetle specimens, the "Ministère des Ressources naturelles du Québec" (MRNQ) uses permanent sampling stations dispersed in all representative types of forest ecosystems and landscapes across the province of Quebec.

Other conventions and symbols. The distribution record for each of the *Pityophthorus* species mentioned in this article is displayed using the following sequences: 1. Name of the locality where the specimen was captured. In some cases, instead of the name of the locality, the historic territorial administrative name may appear (e.g., "Township"), because no locality name has been assigned to the sampling area. 2. Name of the Regional County Municipality (RCM) to which the cited locality belongs. Regional County Municipalities have delineated the province of Quebec territory since 1979. Many localities in Quebec that are situated in different geographic areas have received the same name. To avoid any confusion relative to the locality names, the corresponding RCM is included. 3. Date of capture. If the capture date is missing or it is unreadable on the label, a question mark is included. 4. Number of examined specimens and the acronym of the entomological collection to which they belong. These data are included within parentheses and separated by a coma. 5. Name of host tree species, displayed in italics. In some cases, the host tree data are missing.

The five abovementioned sequences are separated by comas. Locality records are separated by semicolons (;). If a species was recorded many times in the same locality,

the various dates of capture are separated by a slash symbol (/). For each mentioned species, the distribution data are presented in a manner that previous literature records are separated from the new records to highlight the originality of the article. The general distribution of each species in Canada is presented at the end of each species record. The following abbreviations were used for the provinces and territories: **YT**-Yukon Territory, **NT**-Northwest Territories, **NU**-Nunavut, **BC**-British Columbia, **AB**-Alberta, **SK**-Saskatchewan, **MB**-Manitoba, **ON**-Ontario, **QC**-Quebec, **NB**-New Brunswick, **PE**-Prince Edward Island, **NS**-Nova Scotia, and **NF & LB**-Newfoundland and Labrador. The distribution records of all *Pityophthorus* species in Canada are presented according to Bright (1981), McNamara (1991), Wood and Bright (1992), and Bright and Skidmore (1997). The distribution of each *Pityophthorus* species was mapped by using the ARCGIS and ARCMAP software starting from an EXCEL database, which is available at the following web link: www.profs.inrs.ca/cguertin/ZOOKEYS_2013/MENU.html

Results

To date, the following 17 *Pityophthorus* species have been recorded in the province of Quebec, Canada:

***Pityophthorus lautus* Eichhoff, 1872**
http://species-id.net/wiki/Pityophthorus_lautus
Fig. 7

Records from Bright (1981). Aylmer, **Communauté-Urbaine-de-l'Outaouais,** 14-VIII-1920, (3, CNC); **Wakefield**, **Les Collines-de-l'Outaouais**, 11-V-1951, (19, SLWC), *Rhus typhina*; **Sainte-Anne-de-Bellevue**, **Montréal**, ?, (10, CNC) / 2 individuals who supposedly originated from the same samples were found at LEMU and display an unreadable label.

New records. Montréal, 14-V-1936, (9, ECLU); **Mont Saint-Hilaire**, **La-Vallée-du-Richelieu**, ?, (1, LFRC), **Mont Saint-Bruno**, **La-Vallée-du-Richelieu**, ?, (1, LFRC).

Distribution in Canada. NT, **ON**, **QC**, **NB**, **NS**.

***Pityophthorus pulicarius* (Zimmermann, 1868)**
http://species-id.net/wiki/Pityophthorus_pulicarius
Fig. 3

Records from Bright (1981). Chelsea, **Les Collines-de-l'Outaouais**, 20-VI-1917, (6, CNC); **Grand-Remous**, **La-Vallée-de-la-Gatineau**, 17-VIII-1978, (2, LFRC), *Pinus banksiana*; **Wychwood**, **Communauté-Urbaine-de-l'Outaouais**, 21-VI-1917, (2, CNC); **Pointe à David**, **La-Vallée-de-la-Gatineau**, 2-VI-1975, (1, LFRC), *Pi-*

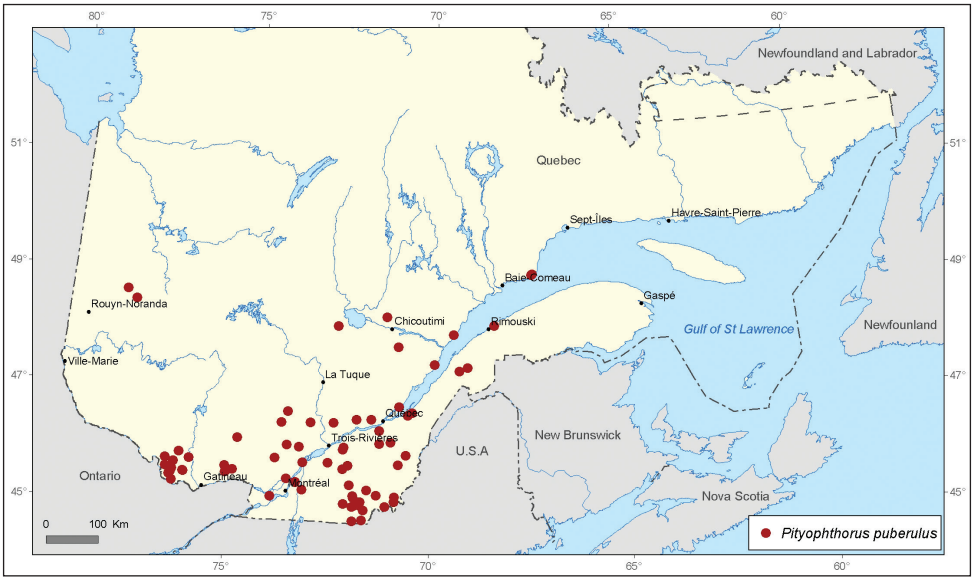

Figure 1. Map of *Pityophthorus puberulus* (LeConte) records in Quebec, Canada.

nus banksiana; **Lac Louvicourt**, **La-Vallée-de-l'Or**, 1-IX-1978, (2, LFRC), *Pinus banksiana*; **Moffet**, **Témiscamingue**, 16-VIII-1978, (2, LFRC), *Pinus banksiana*; **Rivière-aux-Rats**, **Le Haut-Saint-Maurice**, 14-VII-1978, (1, LFRC), *Pinus banksiana*; **Sainte-Anne-de-Bellevue**, **Montréal**, ?, (1, CNC).

New records. Chute-Saint-Philippe, **Antoine-Labelle**, 22-VIII-1990, (1, MRNQ), *Pinus banksiana* / 11-IX-1990, (3, MRNQ), *Pinus banksiana*; **Chemin du Lac Petawaga**, **Antoine-Labelle**, 3-VII-1981, (1, MRNQ), *Pinus banksiana*; **L'Annonciation**, **Antoine-Labelle**, 30-VI-1985, (3, MRNQ), *Pinus resinosa*; **Lac Landron**, **La Vallée-de-la-Gatineau**, 5-VI-1982, (2, MRNQ), *Pinus banksiana*; **Baie Mercier**, **La Vallée-de-la-Gatineau**, 16-VIII-1979, (1, MRNQ), *Pinus banksiana*; **Lac Pageot, Pontiac**, 12-VII-1983, (1, MRNQ), *Pinus banksiana*; **Vinton**, **Pontiac**, 31-V-2011, (1, MRNQ), *Pinus resinosa*; **Chemin du Lac de l'Épine**, **La Vallée-de-l'Or**, 8-VII-1981, (1, MRNQ), *Pinus banksiana*; **Lac Quentin**, **La Vallée-de-l'Or**, 31-VII-1982, (5, MRNQ), *Pinus banksiana*; **Mont Saint-Michel**, **La-Vallée-de-l'Or**, 6-VII-2011, (1, MRNQ), *Pinus banksiana*; **Notre-Dame-du-Nord, Témiscamingue**, 16-VII-1985, (2, MRNQ), *Pinus resinosa*; **Guérin**, **Témiscamingue**, 31-VI-1982, (1, MRNQ), *Pinus banksiana*; **Lac Bend**, **Témiscamingue**, 21-VII-1981, (1, MRNQ), *Pinus sylvestris*; **Latulipe**, **Témiscamingue**, 24-VII-1981, (1, MRNQ), *Pinus banksiana*; **Lac Nodier**, **Témiscamingue**, 16-VII-1981, (1, MRNQ), *Pinus banksiana*; **Lac des Seize**, **Témiscamingue**, 13-VII-1983, (2, MRNQ), *Pinus banksiana*; **Saint-Bruno-de-Guigues**, **Témiscamingue**, 22-VII-2005, (1, MRNQ), *Pinus banksiana*; **Lac à Bédard**, **Témiscamingue**, 22-VII-1986, (1, MRNQ), *Pinus banksiana*; **Cloutier**, **Rouyn-Noranda**, 29-VII-1981, (2, MRNQ); *Pinus banksiana*; **Lac Bruyère**, **Rouyn-Noranda**, 20-VI-1983, (1, MRNQ), *Pinus banksiana*; **Lac Lavoie**, **Rouyn-Noranda**, 15-VII-1981, (1, MRNQ), *Pinus banksiana*; **Lac**

McWatters, **Rouyn-Noranda**, 17-VII-1984, (2, MRNQ), *Pinus banksiana*; **La Morandière**, **Abitibi**, 13-VII-1984, (2, MRNQ), *Pinus banksiana*; **Villemontel**, **Abitibi**, 6-VII-1983, (4, LFRC), *Pinus banksiana*; **Lac Macamic**, **Abitibi Ouest**, 26-VI-1984, (1, MRNQ), *Pinus banksiana*; **Saint-Dominique**, **Abitibi Ouest**, 14-VII-2011, (1, MRNQ), *Pinus banksiana*; **Saint-Georges**, **Le Centre-de-la-Mauricie**, 22-VII-1981, (3, MRNQ), *Pinus resinosa*; **Saint-Antoine-Abbé**, **Le Haut-Saint-Laurent,** 22-V-2002, (2, MRNQ), *Pinus resinosa*; **Saint-Polycarpe**, **Vaudreuil-Soulange**, 5-VII-2002, (1, MRNQ), *Pinus strobus*; **Lac Wet**, **Le Haut-Saint-Maurice**, 13-VIII-1992, (1, MRNQ), *Pinus banksiana*; **Lefebvre**, **Drummond**, 28-V-1999, (4, MRNQ), *Pinus resinosa*; **Lac Roméo**, **Jamésie**, 20-VI-1981, (1, MRNQ), *Pinus banksiana*.

Distribution in Canada. SK, **MB**, **ON**, **QC**, **NB**, **NS**.

***Pityophthorus nitidus* Swaine, 1917**
http://species-id.net/wiki/Pityophthorus_nitidus
Fig. 4

Records from Bright (1981). Tullochgorum, **Le Haut-Saint-Laurent**, 20-IX-1910, (2, CNC); **Sainte-Anne-de-Bellevue**, **Montreal**, ?, (2, CNC); **Saint-Gabriel-de-Rimouski**, **La Mitis,** 8-VII-1970, (6, CCC), *Picea glauca*.

New records. Les Étroits, **Témiscouata**, 24-VII-1986, (2, MRNQ), *Pinus resinosa*; **Saint-Éleuthère**, **Témiscouata**, 2-VIII-1984, (11, MRNQ), *Picea glauca* / 1-VIII-1984, (2, MRNQ), *Pinus resinosa* / 17-VIII-1989, (3, MRNQ); **Estcourt**, **Témiscouata**, 1-VIII-1984, (2, MRNQ), *Pinus resinosa*; **Lac Nadreau**, **La Côte-de-Beaupré**, 9-VIII-1989, (16, MRNQ), *Picea mariana* / 31-VII-1990, (16, MRNQ), *Picea mariana*; **Saint-Alphonse-de-Caplan**, **Bonaventure**, 8-IX-1989, (1, MRNQ); **Saint-Elzéar**, **Bonaventure**, 27-VI-1984, (5, MRNQ), *Pinus sylvestris*; **Lac du Curé**, **Bonaventure**, 17-VI-1996, (4, MRNQ); **Rivington**, **Argenteuil**, 1-IX-1992, (10, MRNQ), *Pinus banksiana*; **Kinnear's Mills**, **Les Appalaches**, 26-VIII-1993, (9, MRNQ), *Picea glauca* / 10-IX-1993, (3, MRNQ), *Picea glauca*; **Sacré-Cœur-de-Marie**, **Les Appalaches**, 5-VIII-1981, (5, MRNQ), *Picea abies*; **Routhierville**, **La Matapédia**, 31-VII-1996, (8,MRNQ), *Picea glauca*; **Saint-Paul-de-Montminy**, **Montmagny**, 24-VII-1981, (3, MRNQ), *Pinus resinosa*; **Saint-Joseph-de-Ham**, **Les Sources**, 21-VII-1981, (1, MRNQ), *Pinus resinosa*; **Les Éboulements**, **Charlevoix**, 4-VI-1981, (1, MRNQ), *Pinus strobus*; **Saint-Hilarion**, **Charlevoix**, 8-VIII-1990, (1, MRNQ), *Pinus strobus*; **Petite-Rivière-Saint-François**, **Charlevoix**, 19-VIII-1985, (2, MRNQ), *Picea abies*; **Lac Rivard**, **Maria-Chapdelaine**, 20-VII-2011, (1, MRNQ), *Picea mariana*; **Lac des Trois Élans**, **Maria-Chapdelaine**, 1-VIII-2001, (1, MRNQ), *Picea mariana*; **Pointe-Lebel**, **Manicouagan**, 7-VIII-1981, (1, MRNQ), *Pinus resinosa*; **Sainte-Eulalie**, **Nicolet-Yamaska**, 11-IX-1984, (2, MRNQ), *Picea abies*; **Saint-Thomas-de-Cherbourg**, **Matane**, 9-VIII-1979, (2, MRNQ), *Pinus banksiana*; **Ruisseau Ernest**, **Antoine-Labelle**, 6-VI-1981, (4, MRNQ), *Pinus strobus*; **Scotstown**, **Le Haut-Saint-François**, 26-VIII-1981, (3, MRNQ), *Picea glauca*; **Saint-Félix-d'Otis**, **Le Fjord-du-Saguenay**, 24-IX-1984, (6, MRNQ), *Pinus resinosa*; **Réser-**

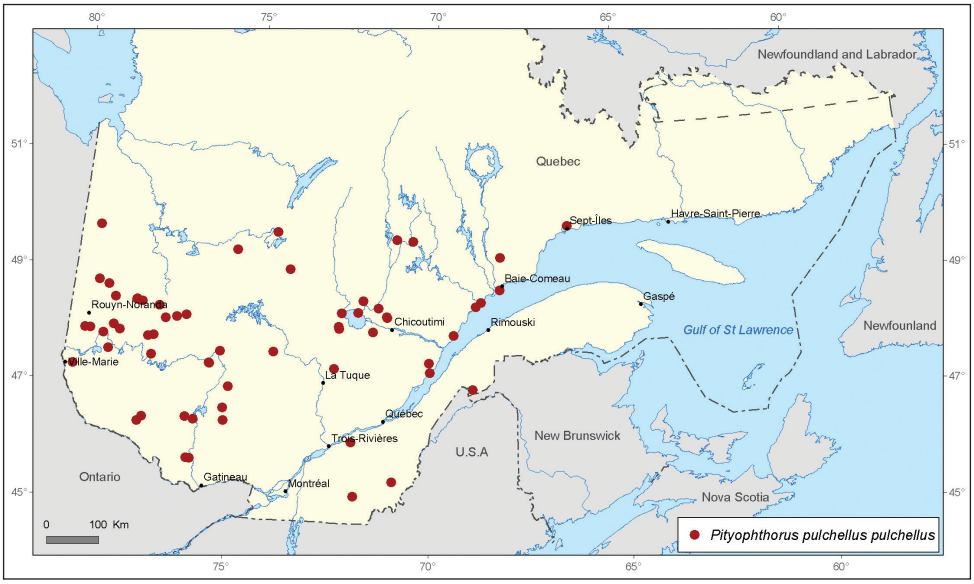

Figure 2. Map of *Pityophthorus pulchellus pulchellus* Eichhoff records in Quebec, Canada.

voir Baskatong, **La Vallée-de-la-Gatineau**, 26-VI-1981, (2, MRNQ), *Pinus banksiana*; **Île d'Anticosti**, **Minganie**, 12-VI-1973, (4, CCC); **Longue-Pointe-de-Mingan**, **Minganie**, 25-VII-1980, (2, CCC); **Sept-Îles**, **Sept-Rivières**, 1-VIII-1982, (2, CCC), *Picea mariana* / 13-VI-1984, (1, CCC) / 8-VI-1985, (71, CCC) / 27-VII-1985, (1, CCC) / 3-VIII-1985, (30, CCC), *Picea mariana* / 24-V-1986, (5, CCC) / 6-VII-1986, (2, CCC) / 5-VIII-1986, (1, CCC) / 29-V-1987, (5, CCC) / 1-VI-1987, (1, CCC) / 7-VI-1987, (1, CCC) / 9-VII-1987, (2, CCC) / 16-VI-1988, (5, CCC) / 12-VII-1988, (1, CCC) / 2-VI-1990, (58, CCC) / 26-VII-1990, (1, CCC) / 23-VIII-1990, (16, CCC) / 10-VI-1991, (1, CCC) / 17-VII-1991, (11, CCC) / 20-VII-1991, (10, CCC) / 30-VII-1991, (1, CCC) / 6-VIII-1991, (4, CCC) / 9-VIII-1992, (4, CCC).

Distribution in Canada. NT, **YT**, **AB**, **BC**, **ON**, **QC**, **NB**, **NS**, **NF & LB**.

***Pityophthorus intextus* Swaine, 1917**
http://species-id.net/wiki/Pityophthorus_intextus
Fig. 9

New records. Saint-Hilarion, **Charlevoix**, 8-VIII-1990, (1, MRNQ), *Picea glauca*; **Lac Fourcet**, **Antoine-Labelle**, 9-VII-1981, (1, MRNQ), *Picea mariana*; **Saint-Hérménégilde**, **Coaticook**, 5-VII-1985, (1, MRNQ), *Pinus resionsa*; **Lac Poutrincourt**, **Le Domaine-du-Roy**, 25-VII-2007, (1, MRNQ), *Pinus banksiana*; **Sept-Îles**, **Sept-Rivières**, 13-VII-1987, (1, CCC) / 16-VI-1988, (1, CCC).

Distribution in Canada. BC, **AB**, **SK**, **MB**, **ON**, **QC**, **NB**, **NS**, **NF & LB**.

Pityophthorus pulchellus pulchellus **Eichhoff, 1869**
http://species-id.net/wiki/Pityophthorus_pulchellus_pulchellus
Fig. 2

Records from Bright (1981). Kazabazua, **La-Vallée-de-la-Gatineau**, 13-XII-1917, (5, CNC), *Pinus banksiana*; **Lac Saint-Jean, Lac Saint-Jean E**, ?, (6, LFRC), *Pinus banksiana*; **Sainte-Anne-du-Lac (Zec Mitchinamécus)**, **Antoine-Labelle**, 4-VII-1978, (48, LFRC), *Pinus banksiana*.

Records from Paquin and Dupérré (2001). Jamésie, 14-IX-1997, (1, LEMU), *Picea mariana*.

New records. Sainte-Françoise, **Bécancour**, 18-VI-1986, (4, MRNQ), *Pinus strobus*; **Colombier** (**Serres**), **La Haute-Côte-Nord**, 16-VII-1986, (2, MRNQ), *Pinus resinosa*; **Les Escoumins**, **La Haute-Côte-Nord**, 6-VI-1984, (1, CCC); **Saint-Ambroise**, **Le Fjord-du-Saguenay**, 6-VII-1992, (1, MRNQ), *Pinus strobus*; **Lac du Grand Détour**, **Le Fjord-du-Saguenay**, 20-VII-2011, (1, MRNQ), *Pinus banksiana*; **Saint-David-de-Falardeau**, **Le Fjord-du-Saguenay**, 9-VII-1996, (1, MRNQ), *Pinus resinosa*; **Sept-Îles**, **Sept-Rivières**, 8-VI-1985, (4, CCC) / 16-V-1986, (3, CCC) / 6-VII-1986 (1, CCC) / 29-V-1987, (1, CCC) / 17-VI-1987, (1, CCC) / 25-VI-1987, (2, CCC) / 13-VII-1987, (15, CCC) / 12-VI-1988, (3, CCC) / 21-VI-1988, (7, CCC) / 4-VII-1988, (3, CCC) / 19-V-1989, (1, CCC) / 9-VI-1989, (1, CCC) / 27-V-1990, (7, CCC) / 2-VI-1990, (99, CCC) / 26-VII-1990, (1, CCC) / 27-VIII-1990, (3, CCC) / 29-V-1991, (22, CCC) / 12-VIII-1991, (1, CCC) / 22-V-1992, (2, CCC); **Lac Saint-Ludger**, **Lac Saint-Jean-Est**, 18-VII-1981, (3, MRNQ), *Pinus banksiana*; **Ruisseau du Pont**, **Lac Saint-Jean-Est**, 31-VII-1984, (10, MRNQ), *Pinus banksiana*; **Notre-Dame-du-Rosaire**, **Lac Saint-Jean-Est**, 1-VII-1981, (1, MRNQ), *Picea glauca*; **Lac Fourcet**, **Antoine-Labelle**, 9-VII-1981, (1, MRNQ), *Picea mariana*; **Chute-Saint-Philippe**, **Antoine-Labelle**, 16-VI-1995, (4, MRNQ), *Pinus banksiana*; **Landrienne**, **Abitibi**, 15-VII-1987, (2, MRNQ), *Pinus banksiana*; **Authier Nord**, **Abitibi Ouest**, 13-VII-1979, (1, MRNQ), *Pinus banksiana*; **La Morandière, Abitibi**, 11-VII-1984, (9, MRNQ), *Pinus banksiana*; **Guyenne Township, Abitibi**, 16-VIII-1983, (1, MRNQ), *Pinus banksiana*; **Lac Castagnier**, **Abitibi**, 9-IX-1986, (3, MRNQ), *Pinus banksiana*; **Villemontel**, **Abitibi**, 31-VIII-1983, (80, LFRC), *Pinus banksiana*; **Lac Dubois**, **Témiscamingue**, 21-VIII-1986, (1, MRNQ), *Pinus banksiana*; **Lorainville**, **Témiscamigue**, 4-VI-1981, (51, MRNQ), *Pinus banksiana*; **Lac Nodier**, **Témiscamingue**, 4-VIII-1981, (1, MRNQ), *Pinus banksiana*; **Cloutier, Rouyn-Noranda**, 30-VII-1981, (4, MRNQ), *Pinus banksiana*; **Lac Surimau**, **Rouyn-Noranda**, 11-VIII-1982, (5, MRNQ), *Pinus banksiana*; **Rapide-Deux**, **Rouyn-Noranda**, 6-VI-1983, (1, MRNQ), *Pinus banksiana*; **Lac Charles, Le Haut-Saint-Maurice** , 17-VII-1987, (1, MRNQ), *Pinus banksiana*; **Lac Wet**, **Le Haut-Saint-Maurice**, 13-VIII-1992, (15, MRNQ), *Pinus banksiana*; **Lac Gosselin**, **Le Haut-Saint-Maurice**, 1-VIII-1981, (6, MRNQ), *Pinus banksiana*; **Lac Louvicourt**, **La-Vallée-de-l'Or**, 6-IX-1984, (1, MRNQ), *Pinus banksiana*; **Lac Tremblay**, **La-Vallée-de-l'Or,** 27-VII-2011, (1, MRNQ), *Pinus banksiana*; **Rivière Mégis-**

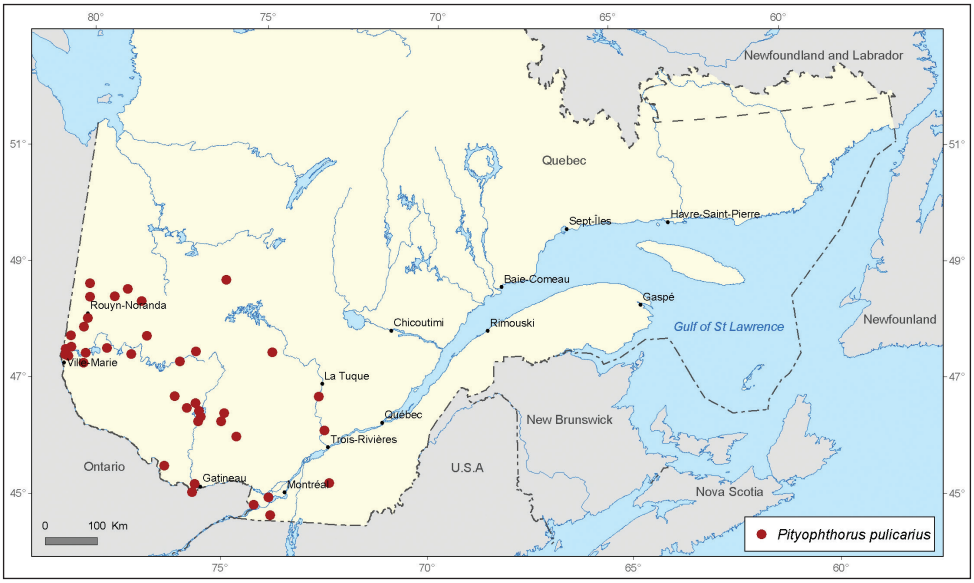

Figure 3. Map of *Pityophthorus pulicarius* (Zimmermann) records in Quebec, Canada.

cane, **La-Vallée-de-l'Or**, 12-VI-1981, (5, MRNQ), *Pinus banksiana*; **Lac Faillon**, **La-Vallée-de-l'Or,** 16-VI-1981, (2, MRNQ), *Pinus banksiana*; **Lac Villebon, La-Vallée-de-l'Or**, 6-VI-1981, (4, MRNQ), *Pinus banksiana* / 2-IX-1981, (4, MRNQ), *Pinus banksiana*; **Lac Fournière**, **La-Vallée-de-l'Or**, 4-VIII-1981, (3, MRNQ), *Pinus banksiana* / 7-VIII-1981, (3, MRNQ), *Pinus banksiana*; **Lac Prospère**, **La-Vallée-de-l'Or**, 22-VIII-1981, (3, MRNQ), *Pinus banksiana*; **Lac Palouse**, **La-Vallée-de-l'Or**, 9-VI-1983, (26, MRNQ), *Pinus banksiana*; **Pointe-Lebel Airport**, **Manicouagan**, 17-VIII-1981, (2, MRNQ), *Pinus resinosa*; **Lac Pistuacanis**, **Manicouagan**, 18-VII-1981, (4, MRNQ), *Pinus banksiana*; **Rivière Betsiamites**, **Manicouagan**, 5-VIII-1981, (1, MRNQ), *Pinus banksiana*; **Lac Saint-Pierre**, **Le Domaine-du-Roy**, 17-VI-1981, (4, MRNQ), *Pinus banksiana*; **Saint-Félicien**, **Le Domaine-du-Roy**, 26-V-2006, (5, MRNQ), *Pinus banksiana*; **Lac Beemer**, **Le Domaine-du-Roy**, 18-VII-2007, (2, MRNQ), *Pinus banksiana*; **Lac Mignault**, **Le Domaine-du-Roy**, 15-IX-2005, (1, MRNQ), *Picea* sp.; **Rivière Désert**, **La Vallée-de-la-Gatineau**, 12-VII-1984, (1, MRNQ), *Pinus strobus*; **Lac Rond**, **La Vallée-de-la-Gatineau**, 22-VI-1983, (52, MRNQ), *Pinus banksiana*; **Lac des Outaouais**, **La Vallée-de-la-Gatineau**, 18-VIII-1981, (6, MRNQ), *Pinus banksiana*; **Lac Mosher**, **La Vallée-de-la-Gatineau**, 26-VII-1983, (9, MRNQ), *Pinus banksiana*; **Lac Danford**, **La Vallée-de-la-Gatineau**, 16-VIII-1980, (3, MRNQ), *Pinus banksiana* / 13-IX-1983, (3, MRNQ), *Pinus resinosa*; **Kazabazua**, **La Vallée-de-la-Gatineau**, 13-XII-1971, (4, MRNQ), *Pinus resinosa* / 28-V-1984 (7, MRNQ), *Pinus resinosa*; **Lac Dickson**, **Pontiac**, 16-VII-1992, (1, MRNQ), *Pinus banksiana*; **Lac Nigault**, **Pontiac**, 29-VIII-1994, (2, MRNQ), *Pinus resinosa*; **Lac Charrette**, **Pontiac**, 5-VIII-1981, (2, MRNQ), *Pinus strobus*; **Bas-de-l'Anse**, **Charlevoix-Est**, 18-VI-1981, (2, MRNQ), *Pinus sylvestris*; **Lac Port au Sau-**

mon, **Charlevoix-Est**, 23-VII-1981, (2, MRNQ), *Pinus banksiana*; **Saint-Sébastien-de-Frontenac**, **Le Granit**, 16-VII-1981, (4, MRNQ), *Pinus banksiana*; **Lac Rivaille**, **Maria-Chapdelaine**, 28-VIII-2008, (6, MRNQ), *Pinus banksiana*; **Bromptonville**, **Sherbrooke**, 31-VII-1981, (1, MRNQ), *Pinus sylvestris*; **Lac Winsch**, **Jamésie**, 12-VIII-1981, (1, MRNQ), *Pinus banksiana*; **Les Étroits**, **Témiscouata**, 24-VII-1986, (3, MRNQ), *Pinus resinosa*.

Distribution in Canada. YT, **NT**, **BC**, **AB**, **SK**, **MB**, **ON**, **QC**, **NB**.

Pityophthorus cariniceps **LeConte & Horn, 1876**
http://species-id.net/wiki/Pityophthorus_cariniceps
Fig. 5

Records from Bright (1981). Sainte-Anne-de-Bellevue, **Montréal,** 17-VIII-1910, (1, CNC), *Pinus* sp.; **L'Île Perrot**, **Vaudreuil-Soulanges**, various dates, (42, CNC) / 4 specimens supposedly originating from the same samples were found at LEMU, *Pinus* sp.; **Old Chelsea**, **Les Collines-de-l'Outaouais**, 23-VI-1966, (14, CNC), *Pinus strobus*; **Wychwood**, **Communauté-Urbaine-de-l'Outaouais**, 2-VI-1917, (5, CNC), *Pinus resinosa*.

New records. Ways-Mills, **Coaticoock**, 13-V-1988, (1, MRNQ), *Pinus strobus*; **Beebe Plain**, **Memphrémagog**, 5-VI-1989, (1, MRNQ), *Pinus strobus*; **Saint-Aimé-des-Lacs**, **Charlevoix-Est**, 26-VI-1992, (4, MRNQ), *Pinus strobus*; **Shawville**, **Pontiac**, 9-V-2001, (3, MRNQ), *Pinus resinosa*; **Lac Hickey**, **Pontiac**, 14-V-2007, (2, MRNQ), *Pinus strobus*; **Lac Prendergast**, **Pontiac**, 25-V-1981, (1, MRNQ), *Pinus strobus*; **Thorne Centre**, **Pontiac**, 26-V-2003, (2, MRNQ), *Pinus resinosa*; **Baie du Chat**, **Pontiac**, 5-VII-1981, (5, MRNQ), *Pinus strobus*; **Fort Coulonge**, **Pontiac**, various dates in the period 2008-2012, (124, INRS-IAF), *Pinus strobus*; **Lac Cayamant, Pontiac**, various dates in the period 2008-2012, (22, INRS-IAF), *Pinus strobus*; **Lac Ruthledge**, **Les Collines-de-l'Outaouais**, 18-VII-1981, (2, MRNQ), *Pinus strobus*; **Sainte-Cécile-de-Masham**, **Les Collines-de-l'Outaouais**, 31-VII-1972, (10, LFRC), *Pinus sylvestris*; **Saint-Charles-de-Mandeville**, **D'Autray**, 13-VII-1981, (5, MRNQ), *Pinus strobus*; **Saint-Zéphirin**, **Nicolet-Yamaska**, 29-VI-1981, (4, MRNQ), *Pinus strobus*; **Les Éboulements**, **Charlevoix**, 4-VI-1981, (2, MRNQ), *Pinus strobus*; **Camp l'Oasis**, **Portneuf**, 12-VI-1980, (1, MRNQ), *Pinus strobus*; **Island Brook**, **Les Haut-Saint-François**, 30-VII-1981, (1, MRNQ), *Pinus resinosa*; **Cookshire**, **Le Haut-Saint-François**, 26-IV-2002, (2, MRNQ), *Pinus banksiana*; **Lemieux**, **Bécancour**, 27-VII-1981, (2, MRNQ), *Pinus banksiana*; **Zec Chauvin**, **La Haute-Côte-Nord**, 13-IV-1983, (5, MRNQ), *Pinus strobus* / 8-VI-1983, (2, MRNQ), *Pinus strobus*; **Mont-Saint-Hilaire**, **La-Vallée-du-Richelieu**, 24-V-1916, (1, LEMU), *Pinus strobus*; **Oka**, **Deux-Montagnes**, 5-VII-1978, (1, CCC), *Pinus strobus*; **Saint-Amable**, **Marguerite-D'Youville**, 11-V-1999, (3, MRNQ), *Pinus strobus* / various dates in the period 2008-2012, (1051, INRS-IAF), *Pinus strobus*; **Saint-Claude**, **Le-Val-Saint-François**, various dates in the period 2008-2012, (85, INRS-IAF), *Pinus strobus*;

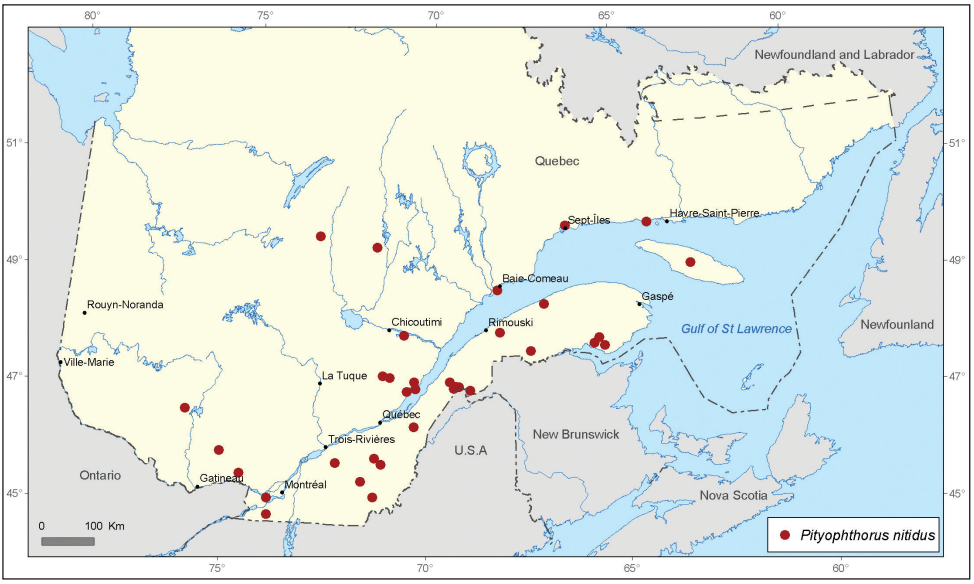

Figure 4. Map of *Pityophthorus nitidus* Swaine records in Quebec, Canada.

Saint-Simon-les-Mines, **Beauce-Sartigan**, various dates in the period 2008-2012, (93, INRS-IAF), *Pinus strobus*; **Cap-Tourmente**, **La Côte-de-Beaupré**, various dates in the period 2008-2012, (178, INRS-IAF), *Pinus strobus*; **Sept-Îles**, **Sept-Rivières**, 8-VI-1985, (1, CCC) / 12-VII-1986, (1, CCC) / 13-VI-1987, (1, CCC) / 10-VII-1987, (1, CCC) / 18-VI-1988, (1, CCC) / 21-VI-1988, (1, CCC) / 4-VII-1988, (2, CCC) / 27-V-1990, (1, CCC) / 29-V-1991, (3, CCC) / 29-VII-1991, (1, CCC); **Lac Ramsay**, **Les Collines-de-l'Outaouais**, 18-V-2009, (1, CCC); **Johnville**, **Compton**, 13-V-1987 (1, CLC) / 17-V-1987 (2, CLC) / 20-V-1987 (1, CLC) / 22-V-1988 (1, CLC) / 17-V-1989 (3, CLC) / 21-V-1989 (1, CLC) / 22-X-1989 (1, CLC).

Distribution in Canada. AB, **SK**, **MB**, **ON**, **QC**, **NB**, **NS**.

***Pityophthorus biovalis* Blackman, 1922**
http://species-id.net/wiki/Pityophthorus_biovalis
Fig. 6

New records. L'Annonciation, **Antoine-Labelle**, 20-VII-1992, (4, MRNQ), *Pinus resinosa*; **Saint-Philémon**, **Bellechasse**, 29-V-1981, (4, MRNQ), *Pinus banksiana* / 20-VII-1981, (5, MRNQ), *Picea abies*; **Lac du Port au Saumon**, **Charlevoix-Est**, 23-VII-1981, (3, MRNQ), *Pinus banksiana*; **Saint-Claude**, **Le Val-Saint-François**, 20-VII-1992, (5, MRNQ), *Picea glauca* / 28-VII-2008, (2, INRS-IAF), *Pinus strobus* / 9-VI-2011, (5, INRS-IAF), *Pinus strobus*; **Quatre-Chemins**, **Les Pays-d'en-Haut**, 18-V-1993, (4, MRNQ), *Pinus strobus*; **Woburn**, **Le Granit**, 9-VII-1981, (2, MRNQ), *Pinus resinosa*; **Lac Cayamant**, **La-Vallée-de-la-Gatineau**,15-VII-2009, (1,

INRS-IAF), **Dosquet**, **Lotbinière**, 20-V-1972, (1, CCC); **Saguenay**, **Le Fjord-du-Saguenay**, 6-VIII-1984, (1, CCC), *Pinus banksiana*.

Distribution in Canada. ON, **QC**, **NS**.

Pityophthorus carinatus carinatus **Bright, 1978**
http://species-id.net/wiki/Pityophthorus_carinatus_carinatus
Fig. 9

Record from Bright (1981): Sainte-Anne-du-Lac, **Antoine-Labelle**, 4-VII-1978, (2, CNC), *Pinus strobus*.

New records. Lac Needham, **Pontiac**, 12-VII-2001, (4, MRNQ), *Pinus strobus*; **Saint-Augustin**, **Maria-Chapdelaine**, 28-VIII-1981, (1, MRNQ), *Pinus banksiana*; **Notre-Dame-du-Rosaire**, **Lac Saint-Jean-Est**, 26-V-1981, (3, MRNQ), *Picea glauca*; **Boilleau**, **Papineau**, 29-VII-2004, (1, MRNQ), *Picea mariana*; **Cookshire**, **Compton**, 23-V-2000, (2, LFRC), *Pinus resinosa*; **Johnville**, **Compton**, 24-V-1987, (1, CLC) / 17-V-1987, (1, CLC) / 18-V-1988, (1, CLC) / 21-V-1989 (1, CLC) / 11-VI-1989, (1, CLC); **Dosquet**, **Lotbinière**, 16-V-1976, (5, CCC); **Lac Cayamant**, **La-Vallée-de-la-Gatineau**,17-VI-2008, (1, INRS-IAF); **Fort-Coulonge**, **Pontiac**, 16-VI-2011, (1, INRS-IAF).

Distribution in Canada. QC, **NB**.

Pityophthorus balsameus **Blackman, 1922**
http://species-id.net/wiki/Pityophthorus_balsameus
Fig. 7

New records. Cap-Saint-Ignace, **Montmagny**, 26-VIII-1998, (2, MRNQ), *Picea abies* / 4-IX-1998, (2, MRNQ), *Picea abies*; **Ways-Mills**, **Coaticook**, 13-V-1988, (5, MRNQ), *Pinus strobus*; **Doncaster Township**, **Les Laurentides**, 7-VII-1981, (1, MRNQ), *Pinus resinosa*; **Saint-Philémon**, **Bellechasse**, 29-V-1981, (1, MRNQ), *Pinus resinosa*; **Armagh**, **Bellechasse**, 16-IX-1979, (1, MRNQ), *Pinus resinosa*; **Sainte-Marguerite**, **La Nouvelle-Beauce**, 6-VII-1981, (4, MRNQ), *Picea abies*; **Mitchell Township**, **La-Vallée-de-la-Gatineau**, 26-VI-1981, (1, MRNQ), *Pinus banksiana*; **Rivière Petit Saguenay**, **Le Fjord-du-Saguenay**, 25-V-1982, (5, MRNQ), *Pinus resinosa*; **Saint-Ferréol-des-Neiges**, **La-Côte-de-Beaupré**, 3-VII-1990, (1, MRNQ), *Pinus resinosa*; **Saint-Joachim-de-Courval**, **Drummond**, 26-VII-2001, (2, MRNQ), *Picea abies*; **Saint-Germain-de-Grantham**, **Drummond**, 24-VII-1981, (1, MRNQ), *Pinus banksiana*; **Sacré-Cœur**, **La Haute-Côte-Nord**, 8-VII-1992, (2, MRNQ), *Pinus banksiana*; **Notre-Dame-du-Rosaire**, **Lac Saint-Jean-Est**, 26-V-1981, (1, MRNQ), *Picea glauca*; **Valcartier**, **La Jacques-Cartier**, 3-VIII-1981, (1, MRNQ), *Pinus resinosa*; **Dosquet**, **Lotbinière**, 9-VI-1970, (1, CCC) / 28-IV-1984, (1, CCC).

Distribution in Canada. NT, **ON**, **QC**, **NB**, **NS**.

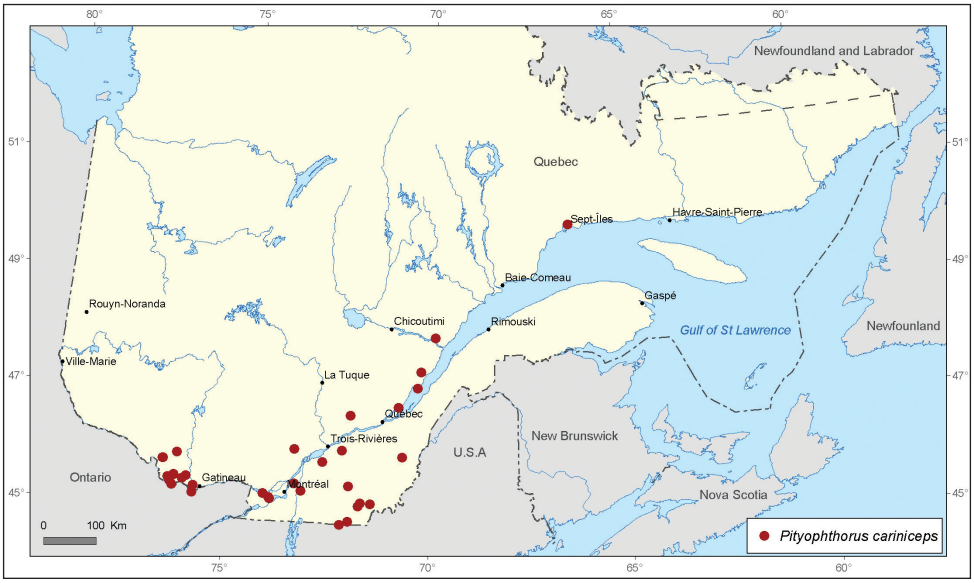

Figure 5. Map of *Pityophthorus cariniceps* LeConte & Horn records in Quebec, Canada.

***Pityophthorus briscoei* Blackman, 1922**
http://species-id.net/wiki/Pityophthorus_briscoei
Fig. 6

Record from Bright (1981). Sainte-Anne-du-Lac, **Antoine-Labelle**, 4-VII-1978, (1, LFRC), *Pinus strobus*.

New records: Villette, **Coaticook**, 18-VII-1985, (6, MRNQ), *Pinus sylvestris*; **Saint-Hilarion**, **Charlevoix**, 8-VIII-1990, (1, MRNQ), *Picea glauca*; **Saint-Hermé-négilde**, **Coaticook**, 8-VII-1985, (3, MRNQ), *Pinus resinosa*; **Poupore**, **Les Collines-de-l'Outaouais**, 30-VI-1992, (4, MRNQ), *Pinus banksiana*; **Simpson Township**, **Drummond**, 19-VIII-1981, (4, MRNQ), *Picea glauca*; **Saint-Joachim-de-Courval**, **Drummond**, 20-VII- 2001, (2, MRNQ), *Picea glauca*; **Island Brook**, **Le Haut-Saint-François**, 30-VII-1981, (4, MRNQ), *Pinus resinosa*; **Rawdon Township**, **Matawinie**, 28-VII-1973, (17, MRNQ), *Pinus resinosa*; **Valcartier**, **La Jacques-Cartier**, 23-VII-1991, (3, LFRC), *Pinus strobus*.

Distribution in Canada: ON, **QC**, **NB**.

***Pityophthorus concavus* Blackman, 1928**
http://species-id.net/wiki/Pityophthorus_concavus
Fig. 8

Record from Bright (1981). Kazabazua, **La Vallée-de-la-Gatineau**, 24-VII-1966, (2, CNC), *Pinus banksiana*.

New records. Cap-Saint-Ignace, **Montmagny**, 4-IX-1998, (2, MRNQ), *Picea abies* / 9.VII.2002, (1, MRNQ), *Picea rubens*; **Armagh**, **Bellechasse**, 16-IX-1979, (1, MRNQ), *Pinus resinosa*; **Doncaster Township**, **Les Laurentides**, 7-VII-1981, (1, MRNQ), *Pinus resinosa*.

Distribution in Canada. ON, **QC**, **NB**, **NS**.

Pityophthorus ramiperda **Swaine, 1917**
http://species-id.net/wiki/Pityophthorus_ramiperda
Fig. 9

Records from Bright (1981). L'Île Perrot, **Vaudreuil-Soulanges**, 30-VII-1910, (1, CNC), *Pinus strobus*; **Sainte-Anne-de-Bellevue**, **Montréal**, 11-VIII-1911, (1, CNC), *Pinus strobus*.

Record from Paquin and Dupérré (2001). Jamésie, 15-VI-1997, (1, LEMU), *Picea mariana*.

New records. Paul-Sauvé Park, Deux Montagnes, 27-VII-1982, (4, LFRC), *Pinus strobus*; **Île-du-Grand-Calumet**, **Pontiac**, 31-VIII-1983, (3, LFRC), *Pinus strobus*.

Distribution in Canada. ON, **QC, NS**.

Pityophthorus opaculus **LeConte, 1878**
http://species-id.net/wiki/Pityophthorus_opaculus
Fig. 8

Records from Bright (1981). Sainte-Anne-de-Bellevue, **Montréal**, ?, (2, CNC); **Gaspé Co**., 2-VIII-1933, (5, CNC), *Picea glauca*; **Hudson**, **Vaudreuil-Soulanges**, 6-V-1910, (1, CNC), *Larix* sp.

Records from Paquin and Dupérré (2001). Jamésie, 15-VI-1997, (7, LEMU) and (2, ROUM) *Picea mariana* / 22-VI-1997, (2, LEMU) and (2, ROUM), *Picea mariana* / 29-VI-1997, (2, LEMU) and (5, ROUM), *Picea mariana* / 6-VII-1997, (2, LEMU) and (1, ROUM), *Picea mariana* / 20-VII-1997, (2, ROUM), *Picea mariana* / 3-VIII-1997, (1, LEMU), *Picea mariana* / 10-VIII-1997, (1, ROUM), *Picea mariana* / 24-VIII-1997, (3, LEMU), *Picea mariana* / 7-IX-1997, (1, ROUM), *Picea mariana* / 28-IX-1997, (1, LEMU) and (1, ROUM), *Picea mariana*; **Lac Duparquet**, **Abitibi**, 12-VI-1994, (1, ROUM), *Cedrus* sp. / 22-VII-1997, (1, ROUM); **Lac Labyrinthe**, **Témiscamingue**, 21-VII-1996, (1, ROUM), *Abies* sp. / 18-VIII-1996, (1, ROUM), *Cedrus* sp. and *Abies* sp. stand.

New records. Lac Hubbard, **La Vallée-de-la-Gatineau**, 31-VII-2001, (3, MRNQ), *Picea mariana*; **Lac Ollivon, La Vallée-de-l'Or**, 12-VIII-2002, (3, MRNQ), *Picea mariana*; **Gentilly**, **Bécancour**, 8-VII-2002, (1, MRNQ), *Picea glauca*; **Petite-Rivière-Saint-François**, **Charlevoix**, 19-VIII-1985, (1, MRNQ), *Picea abies*; **Valcartier**, **La Jacques-Cartier**, 13-VIII-1981, (1, MRNQ), *Pinus resinosa*; **Fort-Coulonge**, **Pontiac**, 25-V-2009, (1, INRS-IAF) / 16-VI-2011, (2, INRS-IAF), *Pinus strobus* / 16-VIII-2011, (2, INRS-IAF), *Pinus strobus*; **Saint-Claude**, **Le-Val-**

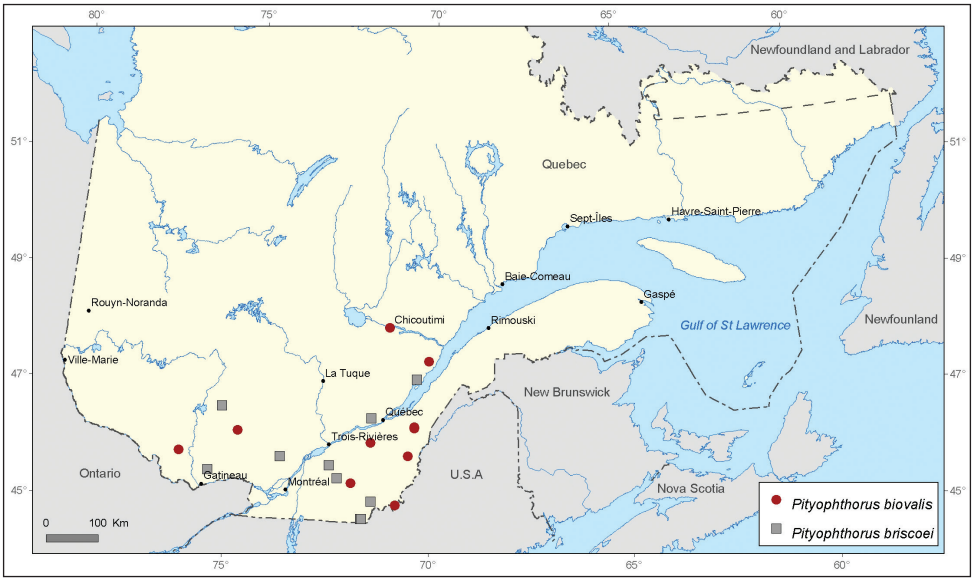

Figure 6. Map of *Pityophthorus biovalis* Blackman and *P. briscoei* Blackman records in Quebec, Canada.

Saint-François, 7-VII-2011, (1, INRS-IAF), *Pinus strobus*; **Sept-Îles**, **Sept-Rivières**, 29-V-1987, (1, CCC) / 15-VIII-1987, (1, CCC) / 12-VI-1988, (1, CCC) / 21-VI-1988, (1, CCC) / 2-VI-1990, (1, CCC) / 26-VII-1990, (1, CCC) / 23-VIII-1990, (1, CCC) / 6-VIII-1991, (11, CCC) / 9-VIII-1991, (1, CCC) / 13-VIII-1991, (1, CCC).

Distribution in Canada. YK, **NT**, **AB**, **BC**, **SK**, **MB**, **ON**, **QC**, **NB**, **NS**, **NF & LB**.

***Pityophthorus dentifrons* Blackman, 1922**
http://species-id.net/wiki/Pityophthorus_dentifrons
Fig. 7

Records from Bright (1981). Gaspé Co., 2-VIII-1933, (10, CNC), *Picea glauca*.

New records. Sainte-Eulalie, **Nicolet-Yamaska**, 11-IX-1984, (2, MRNQ), *Picea* sp., **Fort- Coulonge**, **Pontiac**, 25-V-2009, (1, INRS-IAF), *Pinus strobus*; **Saint-Simon-les-Mines**, **Beauce-Sartigan**, 30-VI-2009, (1, INRS-IAF), *Pinus strobus*.

Distribution in Canada. AB, **ON**, **QC**, **NB**, **PE**, **NS**, **NF & LB**.

***Pityophthorus puberulus* (LeConte, 1868)**
http://species-id.net/wiki/Pityophthorus_puberulus
Fig. 1

Records from Bright (1981). Kazabazua, **La Vallée-de-la-Gatineau**, 24-VIII-1966, (3, CNC), *Pinus banksiana*; **Campbell's Bay**, **Pontiac**, 24-VI-1978, (1, CCC); **Sainte-Anne-de-Bellevue, Montréal**, ? , 1910, (15, CNC), *Pinus* sp. / one specimen

supposedly originating from the same samples was found at LEMU; **Sainte-Marie-de-Beauce**, **La Nouvelle-Beauce**, ?-VIII-1975, (6, LFRC), *Pinus banksiana*.

New records. Saint-Théodore, **Matawinie**, 25-VII-1984, (6, MRNQ), *Pinus resinosa*; **Réservoir Taureau**, **Matawinie**, 10-VII-1981, (2, MRNQ), *Pinus resinosa*; **Baldwin-Mills**, **Coaticook**, 8-VII-1985, (2, MRNQ), *Pinus sylvestris*; **Sainte-Edwidge**, **Coaticook**, 8-VIII-1990, (2, MRNQ), *Pinus sylvestris*; **Saint-Herménégilde**, **Coaticook**, 8-VII-1985, (6, MRNQ), *Pinus sylvestris*; **Trois-Lacs**, **Le Granit**, 24-VII-1986, (10, MRNQ), *Pinus resinosa* / 29-VII-1987, (3, MRNQ), *Pinus resinosa*; **Notre-Dame-des-Bois**, **Le Granit**, 8-VIII-1978, (7, MRNQ), *Pinus strobus* / 26-VII-1979, (5, MRNQ), *Pinus resinosa*; **Clinton Township**, **Le Granit**, 4-VI-1981, (3, MRNQ), *Pinus sylvestris*; **Chénéville**, **Papineau**, 5-VIII-1987, (4, MRNQ), *Pinus resinosa*; **Ripon**, **Papineau**, 8-VII-1992, (1, MRNQ), *Pinus banksiana*; **Notre-Dame-de-la-Paix**, **Papineau**, 16-VII-1993, (2, MRNQ), *Pinus resinosa*; **Lac Quatre Chemins**, **Papineau**, 1-IX-1983, (3, MRNQ), *Pinus resinosa*; **Charteris**, **Pontiac**, 24-V-2000, (2, MRNQ), *Pinus sylvestris* / 6-VI-2000, (2, MRNQ), *Pinus banksiana*; **Thorne**, **Pontiac**, 24-V-2000, (1, MRNQ), *Pinus resinosa*; **Lac Prendergast**, **Pontiac**, 19-VI-1980, (1, MRNQ), *Pinus strobus*; **Lac de la Ferme**, **Pontiac**, 12-VI-1980, (1, MRNQ), *Pinus resinosa*; **Vinton, Pontiac**, 31-V-2011, (2, MRNQ), *Pinus banksiana;* **Lac Lacaille**, **Les Collines-de-l'Outaouais**, 30-VIII-1981, (2, MRNQ), *Pinus resinosa*; **Lac Hamilton**, **Les Collines-de-l'Outaouais**, 26-VIII-1983, (2, MRNQ), *Pinus resinosa*; **Lac de la Grande Fourche**, **Rivière-du-Loup**, 6-VIII-1979, (4, MRNQ), *Pinus resinosa*; **Saint-Pierre-de-Lamy**, **Témiscouata**, 25-VII-1985, (4, MRNQ), *Pinus resinosa*; **Cookshire**, **Le Haut-Saint-François**, 11-VIII-1999, (1, MRNQ), *Pinus strobus* / 23-V-2000, (2, LFRC), *Pinus resinosa* / 30-V-2000, (1, LFRC), *Pinus resinosa* / 14-VI-2011, (1, LFRC), *Pinus resinosa*; **Scotstown**, **Le Haut-Saint-François**, 23-IX-1999, (1, MRNQ), *Pinus sylvestris*; **Bishopton**, **Le Haut-Saint-François**, 23-V-2001, (1, LFRC), *Pinus* sylvestris / 30-V-2011, (1, LFRC), *Pinus* resinosa / 24-V-2011, (1, LFRC), *Pinus resinosa*; **Waterville**, **Compton**, 17-V-2011, (1, LFRC), *Pinus resinosa* / 24-V-2011 (3, LFRC), *Pinus resinosa* / 7-VI-2011, (1, LFRC), *Pinus resinosa* / 14-VI-2011, (4, LFRC), *Pinus resinosa*; **Johnville**, **Compton**, 14-VI-2011, (1, LFRC), *Pinus resinosa* / 27-V-1987 (1, CLC) / 21-VI-1987 (1, CLC) / 19-VII-1987 (1, CLC) / 11-V-1988 (1, CLC) / 22-V-1988 (1, CLC) / 29-V-1988 (1, CLC) / 1-VI-1988 (1, CLC) / 6-VII-1988 (1, CLC) / 21-V-1989 (1, CLC) / 24-V-1989 (1, CLC) / 25-VI-1989 (2, CLC) / 6-VII-1989 (1, CLC) / 9-VII-1989 (1, CLC) / 16-VII-1989 (1, CLC) / 21-IX-1989 (1, CLC); **Huntingville**, **Sherbrooke**, 14-VI-2011, (4, LFRC), *Pinus resinosa*; **Sainte-Marie-de-Blandford**, **Bécancour**, 29-VI-1981, (2, MRNQ), *Pinus resinosa*; **Lemieux**, **Bécancour**, 27-VII-1981, (3, MRNQ), *Pinus banksiana*; **Sainte-Séraphine**, **Arthabaska**, 5-VIII-1993, (2, MRNQ), *Pinus resinosa*; **Victoriaville**, **Arthabaska**, 4-X-1978, (10, MRNQ), *Pinus resinosa*; **Saint-Didace**, **D'Autray**, 19-VIII-1978, (1, MRNQ), *Pinus resinosa*; **Berthierville**, **D'Autray**, 4-IX-1997, (2, MRNQ), *Pinus resinosa* / 27-V-1976, (5, CCC), *Pinus strobus*; **Ruisseau Sainte-Émilie**, **D'Autray**, 19-VIII-1979,

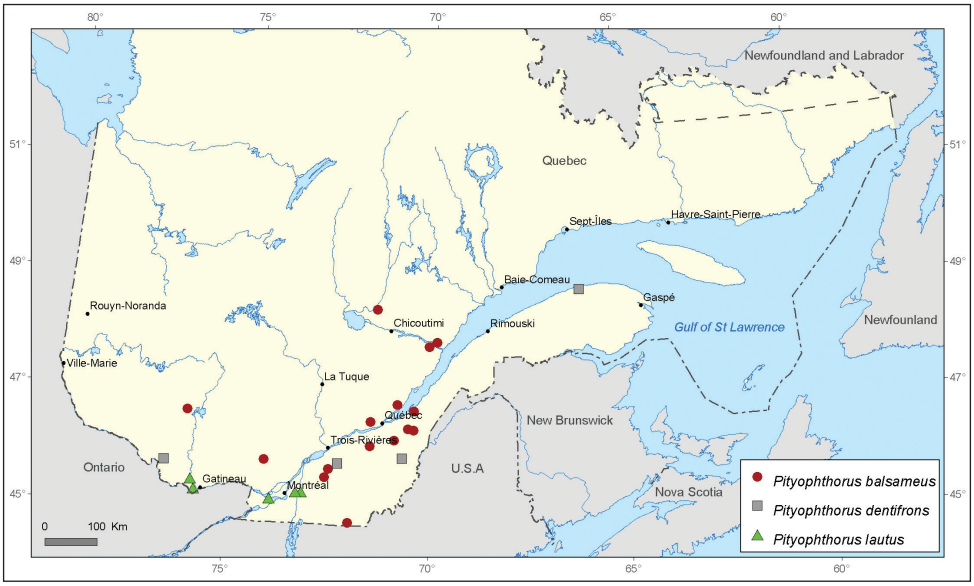

Figure 7. Map of *Pityophthorus balsameus* Blackman, *P. dentifrons* Blackman and *P. lautus* Eichhoff records in Quebec, Canada.

(1, MRNQ), *Pinus resinosa*; **Bromptonville**, **Le Val-Saint-François**, 31-VII-1981, (3, MRNQ), *Pinus resinosa*; **Saint-Adelphe**, **Mékinac**, 30-VII-1986, (5, MRNQ), *Pinus resinosa*; **Lac Éclairé**, **Mékinac**, 30-VII-1980, (2, MRNQ), *Pinus resinosa*; **Saint-Pierre-Montmagny**, **Montmagny**, 7-VIII-1979, (3, MRNQ), *Pinus banksiana*; **Lac Morigeau**, **Montmagny**, 31-VII-2000, (3, MRNQ), *Pinus resinosa*; **Saint-David-de-Falardeau**, **Le Fjord-du-Saguenay**, 8-VII-2000, (1, MRNQ), *Pinus resinosa*; **Ferland-et-Boilleau**, **Fjord-du-Saguenay**, 18-VII-1988, (1, MRNQ), *Pinus banksiana* / 11-VII-2011, (1, MRNQ), *Pinus banksiana*; **Mont Saint-Hilaire**, **La Vallée-du-Richelieu**, 4-VI-2011, (1, LFRC); **Parc de la Mauricie**, **Le Centre-de-la-Mauricie**, 5-VI-2000, (1, LFRC), *Pinus strobus*; **Saint-Basile**, **Portneuf**, 13-VII-2011, (1, MRNQ), *Pinus banksiana*; **Sainte-Luce**, **La Mitis**, 1-VI-1987, (3, MRNQ), *Pinus resinosa*; **Saint-Élie-d'Orford**, **Sherbrooke**, 22-VIII-1978, (3, MRNQ), *Pinus resinosa*; **Saint-Zéphirin-de-Courval**, **Nicolet-Yamaska**, 15-VI-1982, (2, MRNQ), *Pinus resinosa*; **Valcartier**, **La Jacques- Cartier**, 3-VIII-1981, (3, MRNQ), *Pinus resinosa*; **Lac Beemer**, **Le Domaine-du-Roy**, 18-VII-2007, (1, MRNQ), *Pinus banksiana*; **Shenley Township, Beauce-Sartigan**, 2-VII-1981, (1, MRNQ), *Pinus resinosa*; **Saint-Chrétien**, **Charlevoix-Est**, 31-VIII-1984, (3, MRNQ), *Pinus banksiana*; **Baie-Trinité**, **Manicouagan**, 10-VI-1987, (1, MRNQ), *Pinus banksiana* / 31-V-1999, (3, MRNQ), *Pinus resinosa* / 1-VI-1999, (3, MRNQ), *Pinus resinosa*; **L'Annonciation**, **Antoine-Labelle**, 28-VII-1988, (4, MRNQ), *Pinus resinosa*; **Saint-Patrice-de-Beaurivage**, **Lotbinière**, 30-VIII-1989, (6, MRNQ), *Pinus resinosa*; **Landrienne**, **Abitibi**, 15-VII-1987, (1, MRNQ), *Pinus banksiana*; **Saint-Dominique**, **Abitibi Ouest**, 14-VII-2011 (1, MRNQ),

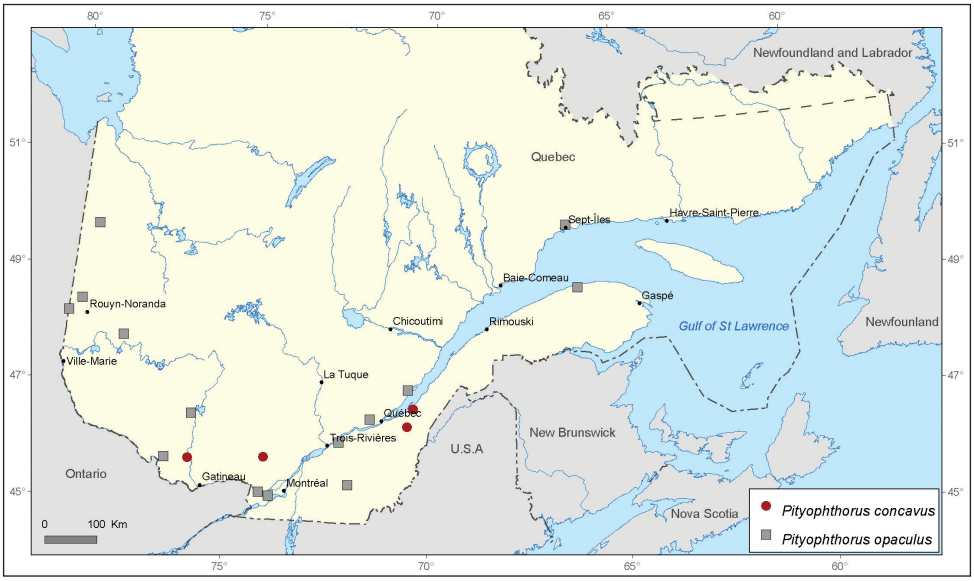

Figure 8. Map of *Pityophthorus concavus* Blackman and *P. opaculus* LeConte records in Quebec, Canada.

Pinus banksiana; **Lachenaie**, **Les Moulins**, 5-VI-2000, (6, LFRC); **Saint-Amable**, **Marguerite D'Youville**, various dates in the period 2008–2012, (12594, INRS-IAF), *Pinus strobus* / 25-V-2000, (2, MRNQ), *Pinus strobus*; **Saint-Claude**, **Le Val-Saint-François**, 31-VII-1981, (9, MRNQ), *Pinus sylvestris* / 31-V-1985, (18, MRNQ), *Pinus resinosa* / various dates in the period 2008-2012, (380, INRS-IAF), *Pinus strobus*; **Fort-Coulonge**, **Pontiac**, various dates in the period 2008-2012, (3391, INRS-IAF), *Pinus strobus*/ 4-VII-2007, (1, MRNQ), *Pinus* resinosa; **Lac Cayamant**, **La Vallée-de-la-Gatineau**, various dates in the period 2008-2012, (38, INRS-IAF), *Pinus strobus*; **Saint-Simon-les-Mines**, **Beauce-Sartigan**, various dates in the period 2008-2012, (564, INRS-IAF), *Pinus strobus*; **Cap-Tourmente**, **La Côte-de-Beaupré**, various dates in the period 2008-2012, (368, INRS-IAF), *Pinus strobus*; **Saint-Étienne**, **Lévis**, 2-VI-1981, (1, CCC) / 10-VI-1983, (1, CCC); **Les Escoumins**, **La Haute-Côte-Nord**, 18-VI-1984, (3, CCC).

Distribution in Canada. ON, **QC**, **NB**, **NS**.

***Pityophthorus consimilis* LeConte, 1878**
http://species-id.net/wiki/Pityophthorus_consimilis
Fig. 10

Records from Bright (1981). Sainte-Anne-de-Bellevue, **Montréal**, ?, (4, CNC); **Gaspé** Co., 15-VIII-1934, (1, CNC), *Picea glauca*; **Kazabazua**, **La Vallée-de-la-Gatineau**, 13-VII-1967, (52, CNC), *Pinus banksiana*; **Sainte-Julienne** (**Kelly's Camp**), **Montcalm**, 17- VII-1939, (2, CNC), *Picea glauca*; **Lac Mud**, **Papineau**, 24-X-1967, (1, CNC).

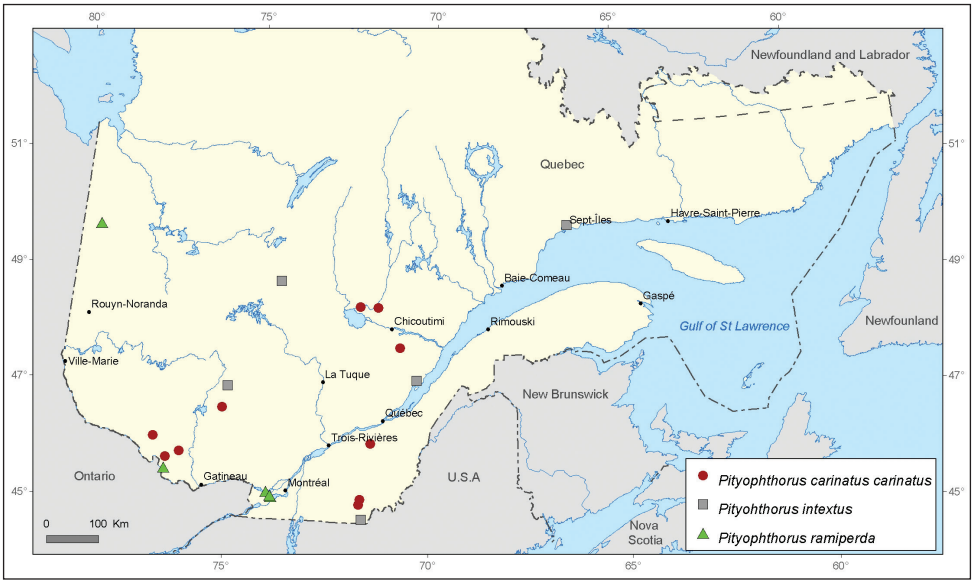

Figure 9. Map of *Pityophthorus carinatus carinatus* Bright, *P. intextus* Swaine and *P. ramiperda* Swaine records in Quebec, Canada.

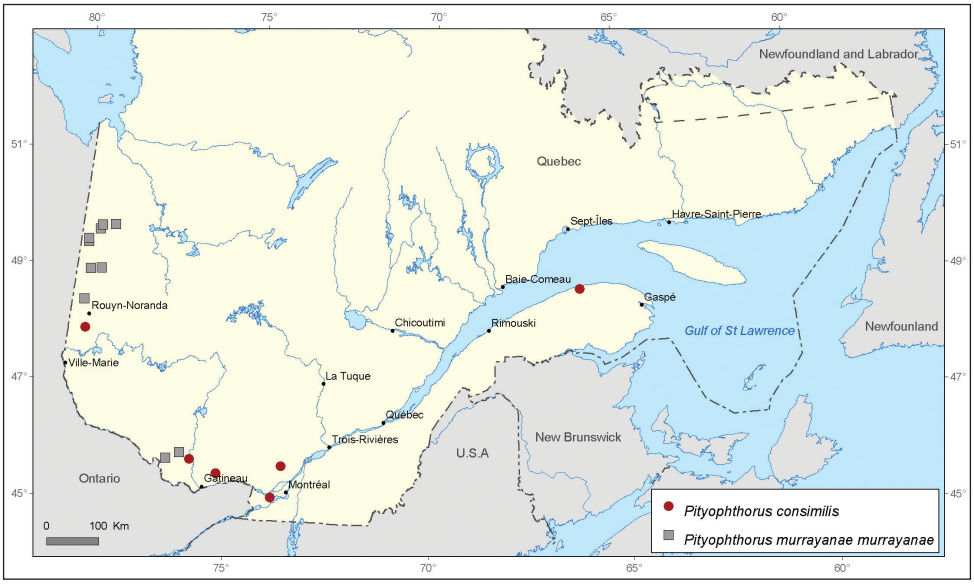

Figure 10. Map of *Pityophthorus consimilis* LeConte and *P. murrayanae murrayanae* Blackman records in Quebec, Canada.

New records. Cloutier, **Rouyn-Noranda**, 30-VII-1981, (1, MRNQ), *Pinus banksiana*.

Distribution in Canada. AB, **BC**, **MB**, **SK**, **ON**, **QC**, **NS**.

Pityophthorus murrayanae murrayanae **Blackman, 1922**
http://species-id.net/wiki/Pityophthorus_murrayanae_murrayanae
Fig. 10

Records from Paquin and Dupérré (2001). Lac Duparquet, **Abitibi**, 19-VI-1994, (1, LEMU); **Jamésie,** 15-VI-1997, (1, LEMU), *Picea mariana* / 29-VI-1997, (1, LEMU), *Picea mariana* / 13-VII-1997, (1, LEMU), *Picea mariana* / 27-VII-1997, (1, LEMU), *Picea mariana* / 6-VIII-1997, (1, LEMU), *Picea mariana* / 28-IX-1997, (1, LEMU), *Picea mariana*.

New records. Fort-Coulonge, **Pontiac**, various dates in the period 2008-2012, (1005, INRS-IAF), *Pinus banksiana*; **Lac Cayamant**, **La-Vallée-de-la-Gatineau**, various dates in the period 2008-2012, (60, INRS-IAF), *Pinus banksiana*; **Lac Villebois**, **Jamésie**, 14-IX-2006, (1, MRNQ), *Pinus banksiana*.

Distribution in Canada. NT, **AB**, **BC**, **MB**, **ON**, **QC**, **NB**.

Discussion

A total of 21 690 specimens of *Pityophthorus* originating from nine entomological collections were analyzed. A total of 291 new localities in Quebec, Canada were recorded for the 17 identified species. The most widespread species in the province of Quebec is *P. puberulus* with 72 records, followed by *P. pulchellus pulchellus* with 62 records, then by *P. pulicarius* with 40 records, *P. nitidus* with 34 records, and *P. cariniceps* with 33 records.

P. puberulus displays a typical northeastern distribution in North America. This twig beetle breeds in various species of *Pinus*, as well as *Abies* and *Picea* (Bright 1981). All *P. puberulus* specimens examined in the province of Quebec were found only on *Pinus* sp., particularly on *Pinus strobus* and *Pinus resinosa* and rarely on *Pinus sylvestris* and *Pinus banksiana*. Accordingly, the distribution of *P. puberulus* in Quebec is positively correlated with the distributions of *Pinus strobus* and *Pinus resinosa*. *P. puberulus* is also a very abundant species, and thousands of specimens may be collected during a field trapping season. Sixty-nine new distribution records are presented for this species in Quebec, Canada. According to Deyrup and Kirkendall (1983), *P. puberulus* reproduces exclusively parthenogenetically at least in part of their distribution area, which may explain their high abundance. Nevertheless, Bright (1981) described the male of this species.

P. pulchellus pulchellus is one of the most widespread species in North America (Bright 1981). The specimens of this species captured in Quebec were found on different pine species, although mainly on jack pine, *Pinus banksiana.* It is highly likely that the lack of occurrence in the northern area of Quebec may be determined by the lack of samples above 51°N. Fifty-eight new locality records are presented for this species in Quebec.

P. pulicarius displays a distribution that is predominantly toward the western area of the province. This species was found in thirty-three new localities in Quebec. The specimens were collected principally on *Pinus banksiana*, as well as *Pinus strobus* and

Pinus resinosa. *P. pulicarius* may be an aggressive species that attacks living twigs of different species of pine (Craighead 1950).

P. nitidus is a species that is widespread in North America throughout the northern coniferous forest (Bright 1981). This species breeds in different species of *Pinus* and *Picea*. In Quebec, this species is distributed predominantly along the Saint-Lawrence River through Anticosti Island, which is the easternmost record (Fig. 4). Thirty-one new records are presented for this species in Quebec.

The distribution of *P. cariniceps* is confined to the southern and, specifically, the southeastern areas of Quebec. Two focal regions of occurrence may be detected for this species in Quebec: the first one is located in Gatineau Valley and the second stretches along the Saint-Lawrence River (Fig. 5). Twenty-nine new distribution records are provided for this species in Quebec. Bright (1981) recognized two types of morphological variation of the female frons and male declivity across the North American distribution area: "*canadensis* form", which is more frequent within the boreal populations, and "*cariniceps* form", which predominates in the southern populations. The specimens of *P. cariniceps* analyzed from the province of Quebec displayed both previously mentioned forms and an extreme variation of the "*cariniceps* form" with a strong and sharp elevation of the female frons. *P. cariniceps*, *P. biovalis*, *P. carinatus carinatus*, *P. balsameus*, *P. briscoei*, and *P. concavus* compose the "cariniceps group". All of these species within the "cariniceps group" are identified mainly according to characteristics of the female frons. However, a significant morphological variation of female frons could be detected in each of the species belonging to this taxonomic group. These variations are sometimes so large that they may lead to misidentification. Therefore, a taxonomic revision of the "cariniceps group" through a combination of their morphological and molecular traits is required.

Several species of *Pityophthorus* occurring in Quebec, Canada display a narrow distribution across the territory. These include *P. consimilis* with 6 records, *P. ramiperda* and *P. intextus* with 5 records, and *P. dentifrons* and *P. concavus* with only 4 records each.

P. consimilis is a rare species in Quebec. Only one new provincial record is presented in the western part of Quebec. The species is also rare in the province of Nova Scotia with only one record (Majka et al. 2007a) and it is absent in other Maritime provinces of Canada (Majka et al. 2007a; Majka et al. 2007b).

P. ramiperda is a very rare species with a limited distribution in the eastern part of North America. This species was initially reported in Canada only in Ontario and Quebec by Bright (1981) and was relatively recently found in the province of Nova Scotia (Majka et al. 2007a). Three new locality records are provided in the province of Quebec for this species, which was most recently cited by Paquin and Dupérré (2001) in the Jamésie Regional County Municipality. This record is the northernmost distribution point of *P. ramiperda* in North America (Fig. 9). This species was previously captured only on white pine, *Pinus strobus*. However, in the northern part of Quebec territory, the species has been captured in a *Picea mariana* stand far beyond the northern distribution limit of *Pinus strobus* in the province. Consequently, it is highly likely that *P. ramiperda* breed in other coniferous species and not just in white pine. This hypothesis remains to be confirmed.

P. intextus was first mentioned in Quebec by Laplante et al. (1991) and later in a publication of the Ministère des Ressources Naturelles du Québec (MRNQ 2008), but no locality records were provided. In the taxonomic monograph published by Bright (1981), this species was not mentioned as present in Quebec. We present five new localities for *P. intextus* in Quebec, and these provide the first reliable distribution data for this species. A closely related species, *P. cascoensis,* which is known to be found in the Northwest Territories, Alberta, Ontario, Newfoundland and Labrador has never been reported in Quebec (Bright 1981; Bright and Skidmore 1997, 2002; Wood and Bright 1987, 1992). According to the distribution in Canada, this species should also be found in Quebec.

P. dentifrons displays a predominantly southeastern distribution in North America. It is also a species with scarce representation in Quebec. Only three new locality records are provided.

P. concavus has an eastern North American distribution, as reported by Bright (1981). Although Wood and Bright (1992) mention some records from British Columbia, the data do not appear to be reliable because no specimen originating from this Canadian province is inventoried in CNC. This species is rare in Quebec. Three new records are included in this article, and these constitute the only records of this species since its first mention in the province. No other specimen has been recaptured recently.

The distributions of *P. lautus, P. biovalis,* and *P. murrayanae murrayanae* display some peculiarities:

P. lautus is a species found in mixed and deciduous forests in Quebec and displays a typical southern distribution. The reduced number of locality records in Quebec may be somewhat explained by the placement of the sampling stations, which were located predominantly in coniferous stands. Consequently, the distribution of this species that we report across the province could be underestimated.

P. biovalis, similarly to *P. intextus*, was mentioned by Laplante et al. (1991) and in the publication of Ministère des Ressources Naturelles du Québec (MRNQ 2008), but no locality records are provided. Thus, we consider all nine locality records as new for the province of Quebec.

P. murrayanae murrayanae provided a very interesting case. This subspecies was first recorded in Quebec by Paquin and Dupérré (2001) in the Jamésie Regional County Municipality, which is also the northernmost mentioned distribution record in Quebec. Three new locality records are provided in this paper for *P. murrayanae murrayanae*, and these represent the second report of this subspecies in Quebec. According to its actual provincial distribution, *P. murrayanae murrayanae* is found only in the northwestern area of Quebec (Fig. 10). Ten specimens from the CNC collection belonging to this subspecies were verified for morphological variation. Specimens from Alberta (3 specimens), British Columbia (3 specimens), Ontario (2 specimens), and New Brunswick (2 specimens) were analyzed. We observed a slight variation in the dimensions of the granules of the elytra declivity. The specimens with west Canadian occurrence display larger granules, whereas the specimens originating from New Brunswick harbor very small granules. The size of the granules on the declivity may

also vary among sexes. Another variable morphological character in *P. murrayanae murrayanae* is related to the pubescence of the female frons (Bright 1981). However, this morphological variation occurs within a population (location) and not necessarily between different locations within the full distribution of the species.

The field samples gathered between 2008 and 2012 in the province of Quebec allowed us to identify some interesting specimens (three specimens) that could not be assigned to any known *Pityophthorus* species. Despite our increased sampling effort, no other similar specimens were recaptured. Further studies will be needed to confirm if novel *Pityophthorus* species could be described or these are simply morphological anomalies.

Conclusions

1. More than 30 % (17 species) of the *Pityophthorus* fauna recorded in Canada is found in Province of Quebec.
2. In general, the our reported distributions of all *Pityophthorus* species in Quebec may be biased by the locations of our permanent sampling stations, which were positioned exclusively in conifer seed orchards and predominantly along the primary river valleys and major roads. The greatest number of distribution points is concentrated along the Saint-Lawrence River and Gatineau Valley. The actual positions of the permanent sampling stations in Quebec are principally connected with the timber industry. Future sampling campaigns should be organized above 51°N to obtain a more realistic overview of the distribution of *Pityophthorus* in Quebec.
3. Diverse types of forest ecosystems, as well as the north-south temperature gradient may potentially shelter more than 17 *Pityophthorus* species. Further studies will be needed to increase the knowledge on the fauna and taxonomy of this twig beetle group in Quebec, Canada.

Acknowledgements

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Museum of Arthropod Diversity, Fort Collins, USA), who kindly accepted to confirm the identification of some of the specimens. We also thank the DGPSP, ministère des Ressources Naturelles du Québec for their financial and field work assistance especially to Régis April and René Chouinard. Natural Sciences and Engineering Research Council of Canada (NSERC) through the iFor Research Consortium also provided financial support for this project.

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